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The American Fire-Alarm and Police Telegraph.

To Dr. William F. Channing of Boston, and Moses G. Farmer of Salem, is due th credit for the first successful employment of electricity for giving instantaneous, universal, and definite alarms in cases of fire. In June, 1851, their plan was accepted by the city of Boston, and an appropriation made to test the experiment.

About the year 1855, Messrs Gamewell & Co. bec.me the proprietors of all the patents of Channing and Farmer for the South and West and shortly after for the entire country. Realizing from the first the incalculable value of the fire-alarm telegrap:, and the neccessity of attaining as near perfection as possible, Messrs. Gamewell & Co. never failed to appreciate and secure every improvement which inventive genius and mechanical skill could develop. It is sufficient guaranty that The Gamewell Fire Alarm Telegraph Company will continue this policy, and that Mr. John N. Gamewell remains as its superintendent.

The fire-alarm telegraph consists of a central battery station, the wire circuits which connect the central station with the street signal-boxes, and the alarm apparatus, consisting of electro-mechanical bell-strikers in church or other tow.rs, electro-mechanical gong-strikers located in engine-houses, public buildings, and residences of fire-department officials, and indicators, showing in plain figures the number of the signal-box from which an alarm originates.

The central office, whether worked by operators or automatically, must have batteries sufficient to supply the necessary electro-motive force, and g.lvanometers for measuring the same, with the switch-board connections necessary to determine the location and character of hindrances to the reliable working of the system.

In the Manual Central office system are signal-circuits and alarm-circuits, the signal-wires connecting the signal-boxes into one or more signal-circuits, as may be desired, and the alarm-wire connecting the bells, gongs, and indic.tors, into any required number of alarm-circuits.

As originally introduced, all alarms from the signal-boxes were received at the central office only, on call-bells, and also recorded by self-starting Morse registers on strips of paper.

An operator in constant attendance retransmitted these alarms, by setting the hands of a manual repeater to the proper number, and putting the repeater in motion, which instantly and simultaneously sounded all the alarm-bells and gongs on the alarm-circuits. The operator, by Morse keys, also transmitted the alarm to a small bell in every signal-box, and the same could be distinctly heard and understood by any person listening. The more modern method is to combine the several registers into a self-starting Multiple Pen Register, one pen for each signal-circuit (see Fig. 1).

This instrument, by making all the records on one strip of paper, enables the operator, with greater certainty and less delay, to retransmit the alarms by means of the manual repeater, consisting of one or more dials (see Fig. 2).

The cut represents a three-dial self-spacing Manual Repeater, so arranged as to repeat alarms as many times as may be desired, and its operation is as follows. Suppose an alarm has been received from signal-box 253. The operator sets the index of the first dial to the left, at figure 2, the second index at figure 5, and the third index at figure 3. He then releases the detent of the clock-work, and the repeater, once started, transmits the alarm over all the alarm-circuits, striking these numbers upon all the alarm-bells and gongs, and repeating it as many times as may be desired.

By this it will be seen that the manual central-office system requires the presence of an operator at all times. This fact—together with the possibility of error on the part of the operator in re-transmitting alarms—suggested the most important improvement which has been made in fire-telegraphs since the original patents of Channing & Farmer. These improvements are comprised in what is called the automatic system, which is so simple, yet so perfect, that even small communities can adopt and maintain it,—in fact, cannot afford to be without it. By its use there is no possible delay in the transmission of alarms, the fire-department being reached instantly by the party giving an alarm, without any intervention whatever.

The automatic central office in its simplest form, is furnished with a battery, lightning-arrester, switch-boards, and galvanometer, located in an engine-house, city hall, police station, or other public building, connected by telegraph-wire with as many street signal-boxes and gong-strikers as the size of the village or town may demand. Bell-strikers and indicators may also be embraced in the system. It may, if desired, have call-bells and registers similar to the manual central office, but its essential peculiarity consists in the automatic repeater used wherever the apparatus comprising the system is sufficient to warrant its distribution over two or more lines or circuits. This repeater, as now constructed (for three circuits), is shown in Fig. 3.

It is so arranged that a signal on any one circuit is instantly repeated on all the others; but if that signal is caused by a break of the wire, the repeater, after sounding one blow on the other circuit, throws the one disabled out of service, leaving the others intact. As soon as the broken circuit is repaired, the repeater automatically takes it into service. The use of this instrument enables one to connect the signal-boxes, bell-strikers, gong-strikers, and indicators, indiscriminately and directly with each other, on two or more circuits through the central office, all the circuits acting and re-acting on each other without human intervention, at the central office. This article will be continued in next edition.

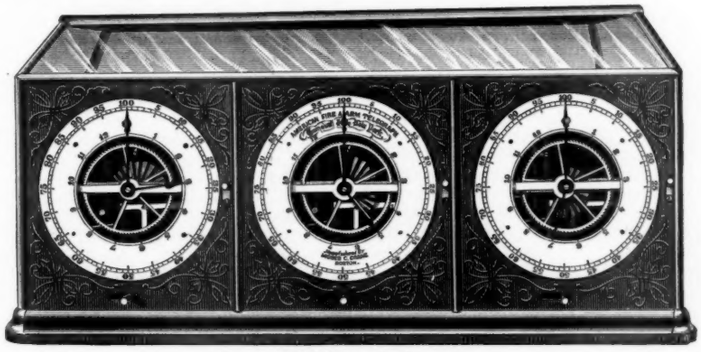

FIG. 2.—THE MANUAL REPEATER.

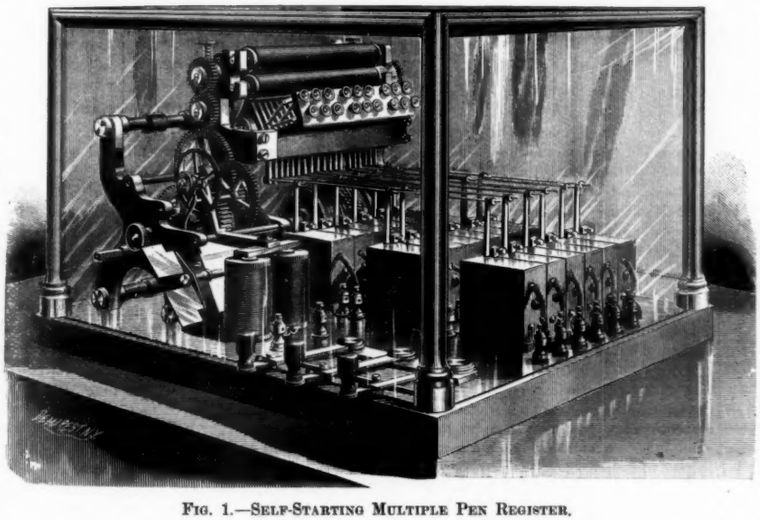

FIG. 1.—SELF-STARTING MULTIPLE PEN REGISTER.

Direct Determination of the Cause of the Deficiency in Dynamo-Electric Machines.

The real existence of a deficiency of power in dynamo-electric machines is at present no longer contested, but there still exist among electricians absolute differences of opinion when it is requisite to determine the cause of this parasitic work and to localize its seat. Dr. Frolich ascribes it to the so-called currents of Foucault, induced during the movement of the machine by the inducing magnetism in the iron of the armature of the Alteneck drum, or of the Gramme ring. I think that in good machines of both types the deficiency is due to a cause of the order of electric resistance, seated in the induced wire.

We see that in the present condition of things it would be desirable that Dr. Frolich's explanation should be correct, since, other things being equal, it would permit us to hope on this side an increase of the yield of the machines when this imperfection shall have been got over.

In any case it is interesting and useful to have a decision on this subject.

The direct mechanical method which I have the honor of presenting to the Academy consists in combining an experimental arrangement, such that according as one or other of the effects is realized in the machine under trial, the deficiency must, necessarily, either be included in two direct measurements which should be identical, or must be included in one only, which must then exceed the other by the value of this known deficiency. It will be understood that if the machine examined suffers from both kinds of injurious effects the experiment will show the proportionate share which they bear in the deficiency.

Hitherto the direct measurement of the mechanical couple during the working of dynamo machines has been utilized only for the generators. It is true that in a generator the measurement is independent of the passive mechanical resistances (air, brushes, &c.); on the contrary in a recipient, the couple measured has to be augmented by the passive resistant couple. I have given an electric method for the determination of the passive mechanical power of machines. Besides, it will be seen that we have here to do only with the difference of two measures,

which must both be augmented by this passive resistance, and which is thus eliminated from the result.

I suppose, then, the dynamo mounted upon bearings independent of the electro-magnets; these bearings support the brushes; the electro-magnets can move freely around the knife-edges which support them in the prolongation of the axis of the steps. I cause the machine to act as a recipient, working on a brake marking t kilogrammeters per second at the rate of n revolutions per minute, under a certain current. A certain effort will tend to turn the electro-magnets in the direction opposite to that of the rotation of the ring. I measure the couple, c, produced by a certain weight expressed in kilos by the length in meters of the arm of the lever when the inductors are brought back to their position of equilibrium before the movement. The work of this couple per second will be

$$\frac{2\pi c n}{60} \text{ kilogrammeters.}$$

If to this work we add the passive mechanical work, we have the totality of the work reproduced mechanically by the recipient.

But the work, t, of the brake, with the addition of the same passive work, gives us a second impression for the total work mechanically recovered.

If the injurious phenomenon is of the dynamo electric order, as M. Frolich supposes, and has its seat outside the circuit foreseen by the constructor, we have

$$\frac{2\pi c n}{60} > t, \text{ and } \frac{2\pi c n}{60} - t$$

will be the entire deficiency, if this kind of effect exists integrally.

On the contrary, if our theory applies integrally to the machine under examination, we have

$$\frac{2\pi c n}{60} = t,$$

and in this case the deficiency must be ascribed to a cause of the electric resistant order—an increase of the metallic resistance of the induced wire, a counter-electromotive force of self-induction, this phenomenon of electric resistance having its seat in the arranged circuit of the machine.

It appears useful to point out this method to experimentalists, since it offers the advantage of an absolute distinctness of conclusion; it avoids, in fact, all reasoning from what passes in certain conditions to what ought to pass when these conditions are modified and is a perfectly direct method.—*M. G. Cabanellas in Cosmos les Mondes.*

The Electromotive Force of Accumulators.

M. Reynier, the well-known electrician, has made experiments on three systems of secondary battery:

(1) the Planté accumulator of reduced lead, peroxide of lead, and sulphuric acidulated water; (2) the copper accumulator of lead, copper, lead peroxide, acidulated solution of sulphate of copper; (3) the amalgamated zinc accumulator of zinced lead, lead peroxide, acidulated solution. His object was to test the electromotive forces of the combinations and find their variations of sulphate of zinc. The accumulators were not completely formed. The electromotive forces were measured during charge and discharge by the method of equal deflection. His results confirm those formerly obtained by M. Gaston Planté, and are as follows: (1) In the three systems of accumulators studied, the secondary electromotive force is notably more elevated during charge than during discharge. The ratio of the smallest of these values to the greatest may be called the *coefficient of fall*. It is a factor of loss which affects the efficiency of accumulators. (2) The fugitive super-elevation of the electromotive force augments with the intensity of the charging current and the electromotive force of the source. (3) In the Planté accumulator the electromotive force is at least 1.95 volts during the charging and at most 1.85 volts during the discharge. The coefficient of fall is therefore 0.95 under the most favorable conditions. (4) In the copper accumulator the electromotive force is at least 1.43 volts during charging and at most 1.25 volts during discharge. The coefficient of fall is therefore 0.87 under the most favorable conditions. The copper accumulator is that which loses most. (5) In the amalgamated zinc accumulator the electromotive force is at least 2.4 volts during charging and at most 2.36 volts during discharge. The coefficient of fall is 0.983 in the most favorable conditions. The amalgamated zinc accumulator is that which loses least. (6) In practice the losses due to variations of electromotive force will be greater than are indicated above, because the times of charging and discharging are generally more rapid than correspond to these experiments.—*Engineering.*

Crucibles and the Electric Light.

An interesting application of the electric light is about to be made at the well-known crucible works of Messrs. Morgan & Co., of Bridgeroad, Battersea. Hitherto it has been the practice to examine the interior of newly made plumbago crucibles by the aid of a gas flame, in order to discover any flaws there may in the material; but the use of a gas flame for such work is both clumsy and disagreeable owing to its flaring nature, and the heat and fumes which arise from it, and blow into the faces of the workmen. Mr. Henry Thame (of Messrs. Thame & Co., Orbell street, Battersea), the inventor of a new primary battery, is about to apply the electric light to the purpose. An incandescent lamp, fitted with a small reflector behind, will take the place of the gas jet with the advantage of clearness, coolness, and convenience. It can be inserted into the inside of the crucible, and the internal surface examined at leisure. Five of these lamps are to be installed, and will be fed by the "chlorochrome" battery, as devised and arranged by the inventor. This battery is remarkably constant and durable in its action, and will keep the lamps going consecutively for forty-eight hours, if need be, without recharging.—*Engineering.*

The Efficiency of Secondary Generators.

The report of Dr. Hopkinson upon the experiments relative to the efficiency of the induction coils of Messrs. Gaulard and Gibbs, has called forth from the scientific press numerous and justifiable criticisms.

Unfortunately, the method employed for measuring this efficiency gave no certainty of accuracy. The objections made to the method of Dr. Hopkinson, on the one hand, and the absence of any satisfactory lamp, or, to speak more accurately, will be a function of this current, and of the number of alternations which succeed each other in the unit of time. The second indication will be equally a function of the total current which traverses the machine. It is not necessary to know the exact signification of the indication of the electro-dynamometer, as we shall presently see.

Let us now place any transformer whatever in the circuit, and maintain the same speed of the machine. However perfect it may be, this transformer evidently will not supply the same number of lamps if we maintain the current which traverses them at the same value as before, and if we do not modify the speed and consequently the number of alternations of the current. The number of lamps will therefore be less, and we shall determine this by grouping them partly in series and partly in derivation, so as to satisfy the two conditions:

1st. Not to alter the current which traverses them individually, and consequently to make them give the same quantity of light as in the first experiment.

2d. Not to alter the total current which traverses the machine.

We may satisfy both these conditions tolerably easily, and we can prove that they are fulfilled by means of the electro-dynamometer, which, placed successively between the lamps and in the general circuit, should give the same indications as when the transformer is not in use.

This done, the mechanical work absorbed in the unit of time by the generator, will evidently be the same in the two experiments, for to the same indication of the electro-dynamometer evidently corresponds the same mechanical effort developed between the fixed and movable parts of the generator, the speed of which has remained unaltered. The useful effect represented by the number of lamps will, on the contrary, have become less, and the value of the true practical return is evidently the relation of the new number of lamps to the old; that is to say, to 100, according to our proposition.

This method is, I repeat, free from any objection. It may be easily applied everywhere; the lamps may besides be replaced by inert resistances.

It is quite as accurate, and is much more easily applied than the calorimetric method, the only one which has hitherto been considered as incontestable, but which is never employed because of the difficulties of all kinds encountered in using calorimeters.—*Electrical Review (London).*

An Electrical Exhibition to be Held in Boston.

Arrangements are nearly completed to hold a grand electrical exhibition in Boston the ensuing winter. It is proposed to make the display the most complete in the field of electricity, showing not only the great inventions that are agitating the public mind from day to day, such as electric lights, telegraph, telephones, etc., but to make it also the most exhaustive in the less-known branches, and in the thousand and one articles that owe their existence in part or wholly to developments in the electrical science.

Such an exhibition, held at the time when the public hears daily of astounding facts that have been discovered in this special branch, and cannot, from want of proper knowledge, grasp the importance of such inventions, will prove an immense educator to the masses, and of great special interest to any one interested in mechanical science and arts. We hear of an electric railway being exhibited and the famous electric boat they had at the electrical exhibition at Paris. While a few special features from foreign countries will be admitted, it is the intention of the promoters of this enterprise to make the exhibition a purely national one, and in choosing Boston as the place to hold it in they pay a high compliment to the intelligence of our New England people, which they will doubtless prove as deserving.

The Electric Light in Surgery and Dentistry.

While the number of patents issued each month in this country for electric appliances is very great, only a few appear to be of general interest, or to mark any great and radical advance in this field. Two recent patents appear of interest from their suggestiveness or promise of future usefulness to the people. The most simple one (properly a new application of an older invention) is the application of the incandescent electric lamp to dentistry. The lamps examined by the writer are inclosed in glass bulbs of the usual shape, an inch long and less than half an inch wide, the source of power being a simple battery of four cells, holding, perhaps, one quart each. To protect the mouth of the patient from the heat of the lamp, the bulb is placed in a casing of hard rubber having an opening at one side covered with glass. The whole apparatus, exclusive of the handle, is about as large as a teaspoon, and is easily held in the mouth. Placed in the mouth with the lips closed over the handle, the entire front formation of the patient's face was visible, showing the position and shape of every bone and tooth through the skin, even the interior of the nasal passages being plainly visible. On holding the lamp behind the teeth with the mouth open, the entire formation of the teeth could be plainly seen. A filling could be traced completely, and the progress of decay in the interior of one tooth (which was not visible at all on the outside) could be plainly seen. In this manner every portion of the mouth could be completely explored in a manner that could not be done by any mirrors reflecting daylight or lamp-light into the mouth. The lamp was left in the patient's mouth for some time, and yet no more inconvenience was said to be experienced than from a drink of hot coffee. To the dentist and surgeon the invention certainly seems, from the examination made, to promise a useful method of diagnosis. It gives information of the interior portions of the bones of the face and the teeth that could be obtained in no other way. When developed, and perhaps tried in other shapes, and with different styles of lamps, holders and reflectors, the invention will, no doubt, prove of great value.

The Daft Motor in New England.

Within the past few months, says the Boston *Herald*, there has very quietly been formed in Boston a company for the purpose of introducing in practical use in New England the electric motors of Leo Daft, the New Jersey electrician and inventor. Among the directors are Montgomery Sears, Charles Whittier (President of the Whittier Machine Company of this city), George R. Blanchard (Vice-President of the Erie Railroad), Louis Belknap (Treasurer of the Northern Pacific Railroad), Joseph T. Bailey (President of the Boylston National Bank of Boston). Mr. D. W. Russell, Mr. E. C. Pike, and others. The company has purchased all of the patents of Mr. Daft, and proposes immediately to begin practical work on a large scale in Boston, having secured the exclusive right as an incorporated company to operate in this State the Daft system. They will offer practical and economical motive power for the running of all kinds of machinery, including railroad cars of every description, elevators, printing presses, sewing machines, etc. The central generator (a six-horse-power machine) is at 12 Federal Street, and motors are now practically working at the printing office of J. S. Adams, 269 Washington Street, and at the Stamp Works of Dimond & Company, 22 Milk Street. The generating machine is about three feet in length, and is in belted connection with a steam engine. The motors at Dimond's and at Adams' are only about two feet in length, and work with perfect success, making about as much noise as a tea kettle coming to a simmer, or a cat purring before the fire. The power is transmitted by thick copper wires, insulated by rubber.

THE PLEASING POINTS.

At an informal meeting of the representatives of the press, held last week in Boston, Professor Mansfield, a co-worker of Professor Daft, gave a very interesting talk on electricity as a motive power, together with some account of Mr. Daft and his inventions, Prof. Mansfield is a graduate of the Institute of Technology, and a pupil of Professor Holman, who was also present at the meeting yesterday, and made some remarks at the close. Professor Mansfield said the three points kept constantly in view by Mr. Daft are safety, economy, and reliability. First, as to economy: It has long been known, through the experiments of Jacobi, Davidson, Wheatstone, Froment, Siemens, Page and others, that under the right conditions the electric power can be furnished at a lower figure than steam. Water power furnishes a ridiculously cheap source of power for generating the electric current, as the electric railway now in operation at the Giant's Causeway practically illustrates. There a simple turbine wheel takes off the power. Steam power, of course, is not so economical. But, used for the generation of electricity at a central station, and transmitted in its transformed state by wires radiating to various points, it can be made to furnish electric power at a much lower rate than is now paid for local steam power. A certain steam printer in Boston pays $1,200 for motive power, including all expense of oil, fuel and engineer. Now the Electric Company say they will furnish the same power for $450, the actual cost of its production being only $200, allowing $75 out of this for interest on machinery and all possible contingencies. For railways the statement

is as follows: A steam locomotive consumes eight pounds of coal per horse-power an hour; but in the case of the large stationary engines used for generating electricity along the track of an electric railroad the consumption of coal is only two pounds of coal per horse-power an hour.

AS TO THE POINT OF SAFETY,

Mr. Daft has succeeded in making his machines perfectly harmless. The armatures he uses are a combination of the Siemens and the Gramme types with his own improvements. The secret of their safety lies in the fact that he uses a low-tension current. At a public exhibition of his motors at Greenville, N. J., Mr. Daft charged the rails of his experimental track with a current sufficient to move several street cars loaded with passengers, and then, connecting the opposite rails by copper wires, placed the ends of these against his tongue. The low-tension current caused not the slightest tremor of pain. The experiment was tried by other gentlemen present. Prof. Holman corroborated these statements of Prof. Mansfield, remarking that Mr. Daft's motors were all perfectly safe. Prof. Holman said that he had witnessed the operation of the Daft motors in the case of two elevators on Spruce Street, in New York, and that friends of his owning these elevators assured him of their perfect working. Prof. Holman said that the thing was now to illustrate the commercial availability of electricity as a motive power, and he thought everything augured its success. At Greenville, N. J., the headquarters of Mr. Daft, the carpenter shop at his factory, or laboratory, has been furnished for one year with a three or four horse-power motor, containing over a mile of wire, and it has run successfully during that time. At Newburg a firm was unable to make steam machinery practicable for hoisting cotton to the fourth story, 70 or 80 feet high. Mr. Daft nine months ago put in one of his motors, and it has run successfully ever since. At Danbury, Conn., in an establishment containing seven or eight sewing machines and other apparatus an electric motor is in use. The railway experiments have been very interesting and significant, so much so that the inventors and capitalists are asserting that the problem of cheaper transportation is now for the first time solved. It is claimed that an electric locomotive is swifter, more economical and less injurious to the track than a steam one. A revolving armature being attached directly to the axle of the driving wheel, and revolving at the rate of 1,000 turns a minute, you get theoretically a speed of two miles a minute, and practically one of from 20 to 95 miles an hour. The electric current itself exerts a tractive or adhesive power, making the wheels bite the rail more firmly. Placed beneath the cars are one or more powerful magnets, which are not ordinarily in use; but, whenever the motoneer (or engineer) wishes to climb a steep grade, he turns a lever and switches off a part of his current into these extra magnets. They at once exert a tremendous pull downward upon the rail, and thus bind it and the wheels closely together, so that the adhesive power of a 10-ton electric locomotive is greater than that of a 40-ton steam locomotive, and most of the wear and tear is avoided.

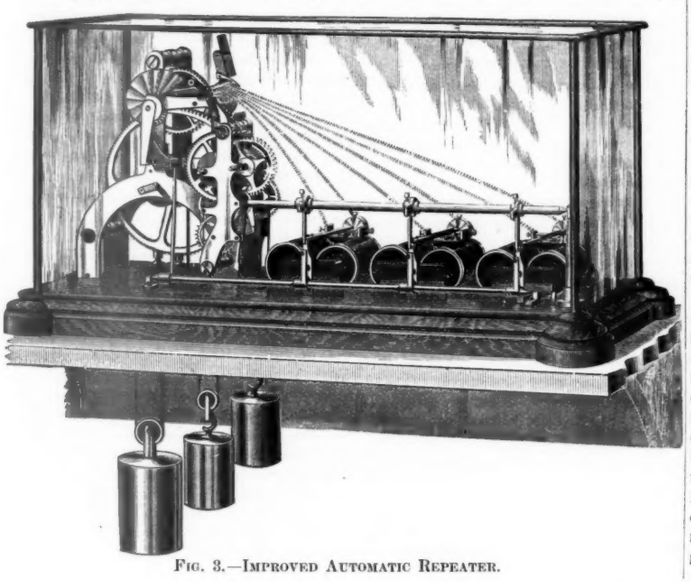

FIG. 3.—IMPROVED AUTOMATIC REPEATER.

The Franklin Institute.

A SKETCH OF ITS HISTORY AND WORK.

The Franklin Institute was founded in the year 1824, the purpose of its originators being to found an institution for the promotion of the mechanic arts, at that time in their infancy in this country. From the period of its establishment to the present, it has actively and honorably fulfilled its mission, and has been so closely identified with many measures for the encouragement and growth of the arts and manufactures, that no history of American industries would be complete which omitted to record its services.

During the sixty years of its existence, it has had the rare good fortune to have been under the leadership and guidance of men distinguished alike for their scientific or mechanical attainments and eminent personal worth, who have jealously guarded its reputation and expanded its powers for usefulness. From the first it has been essentially democratic in character. The learned professor and the artisan have been made equally welcome, and have equally enjoyed its benefits, and from this happy union of science and practice much of the usefulness of the Institute has been derived.

Associated with its past history are the well-known names of Merrick, Ronaldson, Keating, Baldwin, Bache, Agnew, Espy, Harrison, Johnson, Mitchell, Patterson, Frazer, Cresson, and many others of equal eminence; while its roll of membership today embraces the names of all who are identified with the learning and industries that have given Philadelphia her leading position among American cities.

The hall of the Institute is a large and substantial structure of blue stone, situated on the east side of Seventh Street, midway between Market and Chestnut Streets. The corner-stone of this building was laid in the year 1825, and it has been occupied by the Institute to the present time. Upon the first floor are located the lecture room, and the chemical and physical laboratories. The second floor is entirely occupied by the library. This is exclusively scientific and technical in its character and is rapidly increasing. It embraces, in addition to all the standard and current works upon engineering, mechanics, physics, chemistry, metallurgy, etc., complete files of the publications of the principal learned societies of the world, and of the leading scientific and technical serials, besides complete sets of the British, American and French patent reports. The extent and very complete condition of these publications make the library of the Franklin Institute perhaps the most valuable library of reference upon scientific and mechanical subjects in the United States. For this purpose, it is accessible to the public, and visitors from all parts of the country constantly consult its shelves.

The upper floor is entirely devoted to the use of the large drawing classes, composed of young men and women pursuing studies in mechanical, architectural, and free-hand drawing. The drawing school has been carried on uninterruptedly since the establishment of the Institute, and at present is in a most flourishing condition both as to the efficiency of its means of instruction and the number of its pupils.

The rapid growth of the library and schools of the Institute of late years has taxed the ingenuity of its officers to the utmost to carry on its work effectively, the accumulation of books, models, instruments, etc., having become so great as to make it almost imperative to secure more ample quarters. In the collections of the Institute are some interesting historical relics, among which may be named the original electrical machine of Dr. Franklin, Godfrey's original quadrant, the original telegraphic apparatus of Morse, models of Oliver Evans' high-pressure engine and others of less importance.

The Franklin Institute signalized the earnestness of purpose of its founders in the promotion of the mechanic arts, by holding in the year of its foundation, the first exhibition of American manufactures ever held in this country. This historical event occurred in the year 1824, in the old Carpenters' Hall in Philadelphia, and was crowned with complete success. To use the words of a historian of this event, "it attracted large crowds of people, who hitherto had had no conception of the extent and variety of our home productions, and served in many curious and unexpected ways to bring producers and consumers together, and to diffuse a knowledge of our domestic skill and resources." These exhibitions, which in our days have become so popular, have been continued by the Institute at short intervals down to the present, and preparations are now in progress for the holding of an "International Electrical Exhibition," which promises to eclipse in brilliancy all the previous achievements of the Institute in this field of its activity.

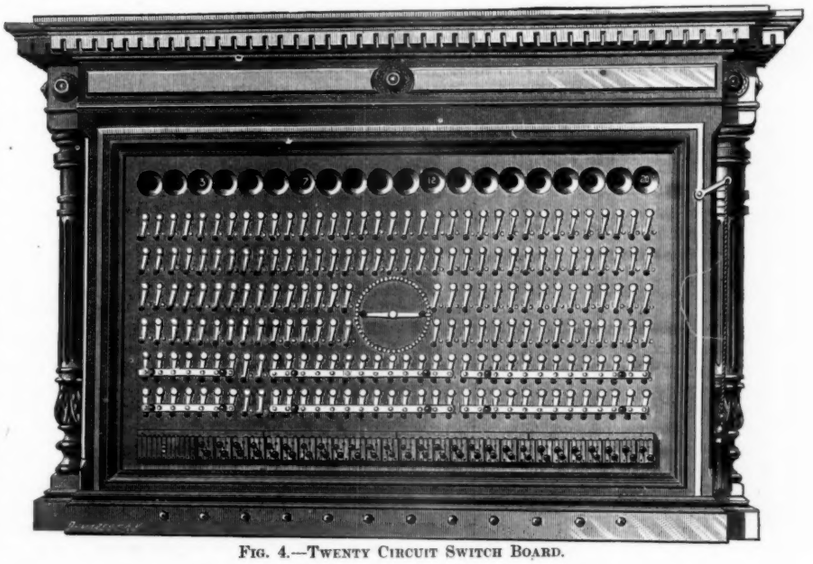

FIG. 4.—TWENTY CIRCUIT SWITCH BOARD.

A passenger-car conductor who had been on the road fifteen years, and during which time he had been turned over embankments, busted up in tunnels, dumped off bridges, telescoped in collisions, blown off the track by cyclones, run into open switches, etc., says that the safest part of a car is that which happens to be in the shop for repairs at the time of the accident.

Exposition at New Orleans.

The Department of State having been informed that the Chinese Government proposed to enter a silk loom in operation as an exhibit at the New Orleans Exposition, the question arose as to whether the Chinese restriction act did not prohibit the landing of the operators on the ground that they were laborers. The question was referred to the Treasury Department, and Secretary Folger has informed the Secretary of State that the Chinese operators would be admitted without molestation, with the understanding that they will not remain in the country longer than necessary to display their exhibit.

The Value of Skilled Labor.

In a recent address, speaking of the great value imparted to certain materials by labor alone, Congressman Chace, of Rhode Island, said:

"It has been shown that to make a ton of pig iron in one of the best managed furnaces of Pennsylvania, it cost $11.58 in wages. But there are many forms of manufacture in which the cost of labor amounts to so nearly the total cost, that the percentage of material is an item hardly worth consideration. In order to illustrate this, take one pound troy weight of steel wire, of which watch screws are made, worth about 62 cents. Of this pound perhaps 20 per cent. is raw material; one pound would make 247,000 screws, which are worth, at wholesale, $1,715 a pound. Now, carry this estimate on into a ton; we shall then have some idea of the amount of labor that enters into the value of the finer manufactures. It is found that a ton of watch screws is worth $4,668,250. The raw material in this ton of screws costs 12 to 14 cents a pound (if we go a little farther back to the pig iron, it costs but one and one-half cents per pound, and even nine-tenths of that labor). By the same method of calculation, it is found that the value of a ton of steel in the form of hair springs is $3,135,744. Comparing this with silver and gold, it is found that fine silver and fine gold at their quoted value amount to the sum of $35,525.71 and $602,928.51 per ton, respectively, and that under the magic touch of the artisan's hand, the baser metal becomes nearly eight times more precious than gold."

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EDITORIAL ANNOUNCEMENT.

Address all communications and make all checks and P. O. orders payable to order of Delano and Company, Proprietors. P. O. Box 3329, New York.

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

NEW YORK, JUNE 7, 1884.

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Six cents a word is, it is said, to be the tariff on the new cables. Of course the old Companies will have to come down to the same figures, and then cabling will be cheap and plenty.

It is an admitted fact that overhead wires serve to dissipate the electricity in the atmosphere, and thus protect cities from lightning. This may be put to the credit of those wires which are heavily loaded on the debit side just now.

The gas folks have been under investigation before a committee of the Massachusetts Senate to see whether they bribed senators to change their votes so as to defeat the water-gas bill. Large sums seem to have been freely talked about, but so far no man has been found willing to admit that he was bribed, nor has any man been found ready to say that he bribed anybody. Funny, isn't it?

Buffalo boasts the tallest telegraph pole in the world. The Western Union put up one measuring seventy feet, and thought thereby to cut the Baltimore and Ohio off from getting its wires to its office, but the Baltimore and Ohio got a pole ninety feet high, eight inches at the tip, and set it up within five feet of the Western Union pole, so that the two now point to Heaven in parallel lines, with the B. & O. a trifle ahead.

We hear of wonderful developments in the matter of incandescent lights. The latest report is that a certain inventor produces twenty sixteen candle lights with an expenditure of only one horse-power. The secret is said to lie in the peculiar character of the filament, and its treatment both before and after carbonization. Full descriptions of the whole process and abundant proofs of all that is claimed for the system are promised at a very early day.

The cool and calm way in which certain daily papers suggest that this and other cities could do a good thing by constructing underground conduits, because "they could borrow the money at four per cent. and charge the electric companies six," is very refreshing this warm weather. Do they proceed on this principle with the horse car companies? And yet the horse cars, invaluable as they are to the public, obstruct the streets far more than the wires.

We notice that, in a new novel, the joint production of several well-known writers, among the "properties," as theatrical people would say, is a "galvanic battery for charging electrical cartridges." It is proper to say that the novel is called a "story of to-morrow," and that its "period" is somewhere along towards the middle of the twentieth century, giving ample time for all sorts of wonderful inventions and discoveries, but it would be interesting to get at the author's idea of an "electrical cartridge."

It does not look much as though Brooklyn expected to put its wires under ground. At the suggestion of Mayor Low it has been decided, in return for telephone service which, at the rates now paid, costs the city $5,150 a year, to give to the New York and New Jersey Telephone Company the exclusive use of the poles belonging to the police and fire departments. There are other cities which might follow this example with advantage to themselves, to the telephone company, and to the public, which does not want to see poles unnecessarily multiplied.

The statement has been made in certain Western papers, and extensively copied in the East, of course, that New York City is to reduce the number of her street electric lights. The facts, as usual, are just the other way. New York is arranging to very greatly increase the number of her electric street lights. It is believed that statements of this sort, which are as frequent as they are false, originate in the fertile but distorted brains of the gas people, who, in every city in the Union, are vainly trying to throw discredit upon the electric light.

Visitors to Boston have thought it strange that so large and prosperous a hotel as Parker's should have no electric lights either outside or in, while almost all the other large hotels use them. The reason is found in the fact that the proprietor, who died last week, was the largest individual owner in the stock of the Boston Gas Light Company. Mr. Parker was one of the most mild-mannered and genteel of men, but on the subject of the electric light he was "sot," and any mention of it in his presence was like holding a red cloth to a bull.

Our article "Concerning Batteries" has called out several communications from inventors and experimenters, and we are glad to learn that there are those who still have faith in the possibility of making a primary battery capable of running incandescent lights for a reasonable length of time and at moderate expense, and are at work upon the problem with fair prospect of success. We fully expect to see such a battery produced, and, as a result, to see the incandescent light in common use within a very few years. Of course theory says that it cannot be done, but theory has made a good many mistakes in the past, and is far from infallible now.

In another column we print the annual report of the Directors of the Cumberland Telephone and Telegraph Company, of Nashville, Tenn., which shows the company to be in a very healthful and prosperous condition. The net earnings are steadily increasing, and so are the dividends, which are now two per cent. quarterly, with a fair prospect of increasing to three before the present financial year closes. Since October 1st, 1883, $53,543.75 have been paid out in dividends, and on April 1st, $4,265 remained to the credit of increase account. The noticeable feature in the report is the rapid increase in earnings and the comparatively slow increase in working expense, as shown by the tabulated statement given.

As is well known, there is a device by which members of a deliberative body may vote simultaneously by electricity, and have their vote, "yea" or "nay," recorded at once by an indicator on the clerk's desk, thus saving much time. But it has not been put into practical use, for the very simple reason that the free and independent legislator seldom cares to vote independently. He wants to know how the others, or at least some of the others, have voted before he makes up his mind, and the electrical device mentioned interferes sadly with this. Then again, the ordering of the "yeas and nays" is usually done for the sake of wasting time, and time-saving devices, no matter what their merit, are considered altogether superfluous and unnecessary.

If our criticism of the working of the telephone in Providence has done no other good, it has certainly served the purpose of calling out the very interesting letter from Mr. Duxbury, which we publish to-day. We commend it to the careful attention of all telephone managers. They will find in it much to interest them, and probably some suggestions that will be new to them, and well worthy of thought. Mr. Duxbury very properly stands loyally by his exchange and its work, and defends both with a vigorous pen. But he must free his mind from the idea that a criticism is an attack. The original criticism was made in perfect good faith, with the idea that *here* was a legitimate opportunity to awaken discussion.

The Overland Company seems to be at Work in Western New York, at least so far as organizing companies and selling stock is concerned. The scheme is to go about a city and get as many people as possible to agree to become subscribers when the new exchange is in operation, of course at rates materially less than those charged by the Bell Company. Then a room is hired, and a show is made of putting up wires, and upon this as a basis the public is invited to come in and take stock. Of course there are always more or less gudgeons that will bite at anything, and the result is that some fish are landed, greatly to the pecuniary profit of the promoters. We do not understand that the business of telephoning has been begun, or that it is likely to begin. Just now stock selling occupies the entire time and attention of the company.

The lightning rod is under investigation just now to determine whether it really does what it purports to do—protect buildings from being struck by lightning. Many instances are cited in which houses, although adequately provided with rods, have been struck, and some have been quick to jump at the conclusion that the idea that the lightning rod protects is a fallacy. That it does not *always* protect is certain, but that it prevents accidents by dissipating, harmlessly, electricity which would otherwise work injury there can be no doubt; that a badly constructed lightning rod is worse than useless is certain, but it is equally certain that when properly constructed and well "grounded," a lightning rod is almost always a sure protection against lightning stroke.

It is in such a week as this, when the whole country is on the alert for news from Chicago, that the wonders of the telegraph have been realized. Everything said or done in the convention has been put upon the wires instantly, and flashed all over the country, so that the results have been known in the remotest places almost as soon as they were known in the building itself. Convention news, by whomsoever sent, is looked upon as public property, and is "taken off" at every little office through which it happens to pass, for the general information of everybody. It is hard to realize that time was when the slow uncertainty of the mail had to be relied upon for such information, and that the country, now impatient at a delay of a few minutes, waited patiently for days before knowing what a convention had done.

Whatever may be said of the advantages and economy of electric propulsion as compared with steam locomotion, there appears to be no question of its value if it could be successfully applied to street railroads. But while its practicability has been demonstrated on suburban roads where the rails themselves may be used as conductors, such a method is obviously not adapted to street service, where electric propulsion should find its most valuable field. Engineering skill has not, up to this time, devised any system that completely overcomes the numerous obstacles to the use of electricity in this connection; but we have information concerning, and have seen drawings illustrating, a system wherein an entirely new method of conducting the power current to the electro-motor on street cars, is employed. The new system is the invention of Mr. William Painter, M. E., of Baltimore, and is not a mere improvement on existing methods, but an entirely new departure, in which all the conditions essential to success appear to have been secured. We are not as yet free to describe the working of the system, but will say its chief merits appear to be complete insulation of the conductors and consequent reduction of leakage to the minimum; entire immunity from danger of short circuiting by vehicles or horses, and cheapness of construction and maintenance. Of scarcely less importance, it may be added, the system offers no obstruction to short traffic, and its operation is not affected by ice, snow or dirt. Mr. Painter's system promises a complete solution of the problem of electric propulsion as applied to street railroads, and it is his intention to secure patents immediately in this and foreign countries. There seems to be little doubt that in a few years we shall witness a complete revolution in street railroad propulsion—the disappearance of the horse and the substitution of the electric current.

A paragraph in the report of the directors of the American Electric and Illuminating Company, printed last week, will bear quoting here, in proof of the groundlessness of the stories set afloat last winter touching danger from electric light wires, and also of the motive behind them. We quote: "It was pointed out that they [electric light wires] were a fruitful source of danger, and numerous cases were cited, with full details, where life and property were destroyed through their agency. Your directors were at pains to investigate these cases thoroughly, and can report that in most instances there was not a shadow of truth in them, and that in the others what little fact underlay them was magnified out of all proportion to its intrinsic value. It was at first difficult to understand who it was that was sufficiently interested to not only manufacture falsehoods outright, but to procure their insertion in reputable newspapers, which not only gave them prominent place, but made them the subject of leading editorial comment. But when it was discovered that a company was organizing in New York to construct underground conduits for all classes of electric wires, and that it was the intention of this company to seek from the Legislature of the State the sole right to dig up the streets of the metropolis for this purpose, to secure which a strong public sentiment based on fear would be very helpful, the moving cause and the motive became apparent. The scheme of the promoters of the company named was nipped in the bud, and, singular to relate, *there have been no accidents from electric-light wires from that day to this.*" Of course, the report is not to be taken literally. There *have* been accidents, neither more nor less, on the average, than before the scheme referred to was exploded, but there has been no attempt to magnify and falsify, for the simple reason that no one was to be benefited by it. We have a copy of the prospectus of that conduit company on file. It is what Horace Greeley used to call "mighty interesting reading."

THE SPUTTERING "TIMES."

Although it is just now heavily weighted with political news and comment, the New York *Times* continues to sputter about the wires, and loses no opportunity to fire a shot at them. In the days of Raymond the *Times* was an able paper, discussing public questions of all descriptions fairly and judicially, having strong and vigorously expressed opinions, and holding to them tenaciously, but never knowingly building up its argument on the basis of a false presentation of the facts If it was not always safe to follow, it was always entitled to respectful consideration. But Raymond is dead, and so is the *Times*, for that matter, for the cheap, sensational, two-cent *Times* of the present is not the *Times* of Raymond's day, save in name. Over and over again it has, in the matter of wires, set up as facts statements which were false, and which it knew were false, and upon these it has built up editorial comments which were as weak in their superstructure as in their foundations.

It seems strange that some reputable daily paper has not taken the pains to investigate this question of overhead wires fairly and without prejudice, looking into it from a practical standpoint, and at least trying to get at an intelligent comprehension of the difficulties that stand in the way of burying conductors of the electric current. A few hours of study would give these sapient writers an idea that possibly there are some things which they do not know, and awaken in their minds a new interpretation of the saying that "fools rush in where angels fear to tread." The field is open for some daily paper to go into a careful, painstaking and honest investigation of the whole matter, and when it does the public will recognize the honesty of its intent, and give it that careful attention which the sputtering of the poor, old decrepit *Times* has failed to evoke.

POLITICS AND THE POLICE TELEGRAPH.

It has been said that "the telegraph is the chiefest of police," and it is certain that no agent has been more potent in securing the arrest and consequent punishment of criminals. In several of our large cities a thorough Police Telegraph system has been adopted, and has been found to very greatly increase the efficiency of the force at a comparatively small cost. On every "beat" there is a box, not unlike a sentry box, to which the patrolman can go and call by telephone or by automatic signals for assistance, or for anything that he may want, or he can communicate important information to headquarters without loss of time and without leaving his post. Again, in the event of some great crime, the details of which it is desirable that every patrolman should know instantly, in order to secure the arrest of the criminal, a certain number of taps on the fire-alarm bells sends every patrolman in the city to his box, where he can communicate freely with headquarters and receive instructions. In a word, the Police Telegraph, with the telephone as an auxiliary, is as clearly valuable and economical as an aid to the Police Department as is the Fire Alarm Telegraph to the Fire Department, and it is a matter of no little wonder to many persons that it has not been more generally introduced, especially when it is considered that with it a city can be well policed with a very much smaller number of men than without it.

It is possible that in this very fact is to be found the reason for the backwardness of certain city governments to introduce it. We remember distinctly that some years ago it was proposed in a certain city to introduce an electric gas-lighting system. The wires were to extend from the office of the superintendent of street lamps and to be hung from lamp-post to lamp-post. By an ingenious device the pressing of a key in the office turned on the gas at one lamp after another, and an electric spark ignited it. Absolutely no lamp-lighters were required, and it was shown beyond doubt or the possibility of mistake that the introduction of the system would work great economy. But the city fathers voted it down, and one of them was frank enough to say plainly that so long as every lamp-lighter had a vote he had no desire to do away with them, no matter what the saving might be. Is it not possible, nay, is it not probable, that a very potent reason why the Police Telegraph, which would permit cities to reduce their force without reducing its efficiency, has not been more generally introduced, is to be found in the fact that politicians think more of votes than of either efficient service or public economy?

A Thermo-Generator.

A telegram from Indianapolis, under date of May 27th, says: For about nine days now a thermo-electric generator has been supplying a current of electricity sufficient to operate four wires, two to Louisville, one to Mattoon, Ill., and one to Union City in this State—the total length of the wire in operation exceeding 600 miles. As to the machine itself, all that the observer sees is a copper boiler, of perhaps two gallons capacity, mounted on the frame of a sewing machine. Underneath the boiler is a coal-oil lamp which is burning with about the flame used to partially illuminate a sick room. It has been burning continuously for eight days and nights, except when being replenished, and had consumed less than 20 cents worth of oil. In front of the boiler is a gauge which marked 100 degrees of heat. Inside of the boiler were scraps of metal protruding from a white substance which might be flour or plaster of Paris. Attached to the boiler is an automatic regulator.

In response to questions as to the nature of his discovery the inventor said that it had long been known to the scientists that the juxtaposition of certain metals would create electricity, and that the process of generation would be accelerated by the application of heat. This knowledge had, however, remained inapplicable to practicable purposes from three causes—first, the amount of heat required was so great as to cause rapid fracture of the combined metals, and thus rendering any machine previously invented short-lived, and consequently expensive; second, the current of electricity generated was uneven and unsteady; third, the high degree of heat involved a great expenditure for fuel. That he had overcome the third difficulty was apparent. That he had overcome the second he held to be proved, for telegraphic service requires a perfectly uniform and steady current of electricity, and this he had maintained for nine days. Whether the other obstacle had been overcome was now being tested, and the test would be continued for thirty days. If at the end of that time all is well with the little machine he will give a demonstration with one big enough to create something like a revolution in the use of electricity. At present he declines to expose the different combination of metals by which he has secured these results. Telegraphing is one of only a few uses to which the thermo-generator can be applied. The small apparatus now in use was made in the presence of your correspondent to operate an engine which would run a swift sewing machine, or keep the press of a conntry paper going, and furnish light for half a dozen electric lamps in the bargain, all at a cost of 15 cents a week. A larger machine, it is said, would run the elevator of a first-class hotel and light every room in the house for a quarter of a dollar. It could also be used for propelling and lighting street cars. In fact, its uses were boundless. There is now only one question to be solved before the success of the invention is determined. It is the one of durability.

The necessity of a new fire and police alarm telegraph system in this city was again illustrated on Friday night by the great fire at the Atlantic Oil Refinery near Point Breeze. The first alarm of what afterwards became the most destructive oil fire ever known in Philadelphia was sent out from the Bell Telephone Exchange at 10.24 P. M., which was ten minutes before the alarm box at Point Breeze was struck. The owners of the Gamewell system ought to move on our city authorities at once.—*Philadelphia Era.*

The war of the underground companies has broken out in Chicago, where the Chicago Sectional Electric Underground Co. filed a bill in the Circuit Court on the 2d inst., asking that the city of Chicago, the Baltimore and Ohio Telegraph Company, the Commissioner of Public Works and the Baltimore and Ohio Railroad Company be restrained from laying telegraph conduit pipes under Jackson or La Salle Streets, on the ground that a monopoly of the underground telegraph wire business of the city was given to the company by a city ordinance. The Baltimore and Ohio Company has begun work and intends to press operations, having the assurance of the city authorities that the requisite permission will not be withheld. A preliminary injunction was issued.

The particulars of an odd occurrence are given by the *Manufacturers' Gazette* of May 17: During a late storm which raged with great force at Greenville, Mass., lightning ran by the telephone wire to the Windsor Mill. There is no telephone in the mill, and the wire is disconnected just outside the building. The lightning was led by the wire to the corner of the mule and weaving rooms, and entered the building under the jet. It followed the water pipe and set the sprinklers going, and at the same time fired the stock in the mules. By this singular provision of an active extinguishing agent at the moment the fire started, serious loss was prevented, as the fire was soon drowned out.

The Magnetic Polarity of Iron.

Captain John Hayden, of Bath, Me., author of "The Requisite Nautical Assistant," writes us that as long as forty years ago he practically tested, on shipboard, the influence of upright iron bars or masses of iron on the needle. He says: "Iron rods or bars, in a horizontal position, exert but little force on the compass, but the same amount and form of iron placed vertically produce an immense effect on the needle. The iron rod immediately becomes magnetic when placed in a vertical position, its magnetism increasing with the length of time it so remains, although it manifests no magnetism when parallel with the horizon. This effect on iron is most marked when the rod is held or placed in the magnetic meridian, and in the direction of the tipping needle, which is in this country with the bottom end swung to the north about thirty degrees from the perpendicular."

Faure-Sellon-Volckmar Accumulators.

The Electrical Power Storage Company (limited), of London, advertises that a reduction has been made in the prices of the F.S.V. electrical accumulators, and that some new types are ready for supply. The ordinary accumulator cell, with either glass or wooden boxes, contains fifteen plates per E.H.P., the normal rate of charge being 20 ampères, and of discharge 30 ampères. A stronger pattern, with thirteen plates, is also made, having a discharge rate of 26 ampères. These are intended for use where extra durability is desired, and where the accumulator may be liable to overcharging. For temporary installations and lighting purposes requiring portable accumulators not liable to be damaged by removal from place to place, cells are specially constructed in suitable boxes. Where small weight is required, combined with rapidity of discharge, as for motive power, laboratory work, etc., small plate cells are made, in either wood or ebonite boxes. Special cells are constructed, with plates of extra strength, for use as regulators for installations on the incandescent system. These entirely prevent the fluctuation in the light otherwise produced by every irregularity in the action of the engine. They can also be used in the customary manner for a small number of lamps during the hours that the engine is not running. Further particulars, as to price, etc., may be obtained on application at the office of the company.

Free Delivery of Messages.

To the Editors Electrical Review:

I wish to know if a telegraph company is legally bound to deliver free a prepaid message addressed to Chicago within the boundaries of the municipality? We live on Jackson street, about two blocks from Western avenue, which is the terminus of the street railroad; but the city boundary is some four or five blocks beyond us. Frequently prepaid telegrams come to our residence on the delivery of which a tax of 25 cts. is demanded and, of course, paid. I have had to pay 25 cts. several times for telegrams sent me from Clark street in this city. Father, having had to pay the tax, felt angry, and on the spur of the moment wrote a complaint to one of the city papers; but though none of us watched for its appearance, this fact is certain that in November last he received a night message from New York, for the delivery of which no tax was demanded. Still the question stands good—are telegraph companies legally bound to deliver prepaid messages free within municipal boundaries? Respectfully,

W. G. T.

[When the Western Union Telegraph Company's city lines were first established, some fifteen years ago, Western avenue was the West limit of Chicago. At that time a charge of 10 cts. was made for delivery of each message to any point West of Halsted street, and South of Twenty-second street. Just after the fire in October '71 this charge was discontinued, and messages for all points between Western avenue and the Lake were delivered free.

Only an occasional message was received for delivery west of Western avenue, and these were sent out by special messenger who collected 25 cts., 10 cts. for car fare and 15 cts. for his time. As the territory west of Western avenue became more thickly settled this charge was felt to be a burden to those who used the wires more frequently, and, although the business was not sufficient to justify the opening of an additional office, it was deemed advisable to discontinue such special charge, and for several months such delivery has been made by the Western Union Telegraph Company's messengers to pay car fare. When it is considered that on some of these messages the company only receives 15 cts., yet pays out 10 cts. for their delivery, business men will be likely to consider the present method a greater mistake than the former, as the company, it seems, is quite liberal in the matter.—ED.]

Electric Lighting on a Small Scale.

To the Editors Electrical Review:

As I desire to make an effort to introduce electric lighting into this town, I would like you to advise me as to the best and cheapest system, their charges, and such other information as may prove useful to me in my undertaking. I have a small engine of somewhere between $\frac{1}{2} \times \frac{1}{2}$ horse-power, and I would like to ascertain whether there are dynamos and lighting fixtures with a capacity to correspond with the above; I mean for a single light? TEXARKANA.

[Arc lights require from three-fourths to a full horse-power each, so that it is hardly probable that the little engine named would be of use. As to the system to be used, we would recommend "Texarkana" to write to the several companies engaged in arc lighting and get their figures. To say which is the best system is like trying to say which is the best piano or best sewing machine—no fellow can find out. We will say, however, that successful electric lighting depends a good deal on the engine, which should be used for that and nothing else.—ED.]

The Thomas Electric Light and Power Company, of Ottawa, Ill., has 75 Thomson-Houston lights, and contemplates extension by the addition of an incandescent plant. The Twin City Gas Company, of La Salle, Ill., has a plant of 25 Thomson-Houston lights now running, and its order has been given for another machine of the same capacity.

Telephonic News

*** Work is being pushed very rapidly on the ex-territorial lines of the Hudson River Telephone Company.

*** The annual meeting of the Rocky Mountain Telephone Company will be held at Ogden on June 9th.

*** Mr. Frank Harrington, superintendent of the Western Electric Company's factory in Boston, returned from Europe in the Alaska, reaching New York on Tuesday. He made a quick trip, having sailed from New York April 12th.

*** The folks at 40 Pearl street, Boston, mustn't cut a subscriber off when he is in the middle of his talk, and then leave his line open so that he can't ring up to expostulate. It is terribly provocative of profanity and it will not do. Col. Parker is charged with the execution of this order.

*** In Maine a new telephone line is nearly completed between the Lewiston and Augusta exchanges by the most direct route. An extra line wire also will take in the villages of Sabattus and Monmouth. The telephone company is also thoroughly reconstructing the lines between Portland and Portsmouth, N. H., and will add another wire the entire distance Barnes & Snow, of Bangor, are contractors for the work.

*** In Hamburg, heretofore, telephone rates have been based on the subscriber's distance from the central office. Now it is to be based on the actual length of the wire connecting his house with the "central." This has made a big addition to the rates hitherto charged, and there has been no end of "kicking." But in Germany, the telephone, like the telegraph, is a Government monopoly, and "kicking" is of no avail.

*** Some time ago the mayor of Sioux City, Dakota, ordered telephone poles on a certain street in that city cut. The telephone company obtained a permanent injunction and commenced resetting the poles, when the police arrested the men, and they were fined. The matter was again brought up before Judge Palmer, who rendered a decision in favor of the telephone company, fining the mayor, marshal and police justice for contempt. The telephone company, now having the permanent injunction sustained, have instituted suit against the city for damages.

*** We always esteem it a favor when friends send us information, and have to thank Mr. William T. Pullen, manager of the Texarkana Telephone, for a recent letter from which we extract the following: "The duties of E. K. Baker, Division Superintendent of this division, have been increased by his appointment to the division of Mr. Clower, resigned. Mr. Baker is a most efficient officer, and one of the most zealous of this company's officials. This company can boast of some of the finest and best appointed exchanges in the South, and, I may add, in the Union. They are rapidly networking the States of Arkansas and Texas with ex-territorial lines, and ere long will have established a thorough system of communication from Little Rock, Ark., to Galveston, Tex.

*** The Mexican Telephone Company has 514 instruments in use in the city of Mexico, 200 in Guadalajara, and will soon have 100 more on the outside line to Ameca. The company is now the owner of the Les Andres, Watson, Berliner, and Bell & Blake patents and rights to patents for the republic of Mexico, and has lately acquired by act of the Mexican Congress the exclusive right to import telephonic material into the republic, the exclusive right to erect poles in the federal district of Mexico, and the exclusive right to transact the telephone business in said district—these several concessions running ten years. Furthermore, the terms have been agreed upon for a new contract for instruments with the American Bell Company, the latter to sell to the former exclusively for a period of three years.

Annual Report of the Cumberland Telephone and Telegraph Company, Nashville, Tenn.

The Board of Directors submit the following report of the operations of this company for ten months, ending with April 1st, 1884, the beginning of the fiscal year:

The existence of this company dates from June 1st, 1883, at which time its capital stock issued amounted to $1,020,000,000, since which time there has been issued in part payment of a line from Nashville to Hendersonville, Tenn., $300.

Capital stock, April 1st, 1884, $1,020,300.

June 1st, 1883, it had a total of 1,998 subscribers, divided among twenty exchanges. April 1st, 1884, it had 2,698 subscribers, divided among 26 exchanges—an increase of 700 in ten months, or a monthly increase of 70 new subscribers.

June 1st, 1883, it had about 1,000 miles of extra territorial or toll lines. April 1st, 1884, it had about 1,500 miles in working order, all of which, without exception, are paying handsomely.

June 1st, 1883, it had about 100 different cities and villages connected by toll lines. April 1st, 1884, about 140 were connected. The number of miles of extra territorial lines, and the new towns being brought into our system, are steadily increasing, and the field for future growth is still very large.

Your Board has thought it prudent to interest the communities wherein we do business in the stock of this company, so as to get the cordial aid and influence of the people locally, and, with that view, have (whenever satisfied the business warranted the building of the lines) offered to build lines wherever the influential men in that vicinity subscribed for stock at par to the extent of one hundred dollars for each mile of wire.

The intention is to interest only active, prominent men, who will consider their subscription a permanent investment. Your approval of this plan of action will be asked at this meeting, it being thought best to push this branch of development during the summer months, while ordinary business in our cities is likely to be quiet, so that in the early fall our entire attention can be given to increasing the list of subscribers to our large exchanges.

We have expended in construction, for the development of our extra territorial lines and exchanges, notably in and around Memphis, Tenn., during the ten months, $54,261.14. Of this amount, $17,053.88 was taken from the prepaid rentals, and will have to be repaid from the funds supplied for construction.

On May 1st, your Board, for the purpose of reimbursing the income account for the amount mentioned above, and to provide funds for construction purposes for the enlarging of our exchanges and lines, thought it best to offer to stockholders of record of May 1st, 1884, the right to subscribe for their proportion of a ten per cent. increase in the capital stock of this company at fifty cents on the dollar. It is thought that this fund, with the proceeds arising from the sale of stock to local people at par as outlined above, will give the company ample funds to continue its policy of vigorous development for some time to come.

Your Board is pleased to note that the increase in subscribers during March amounted to 101, and was greater than during any preceding month. Plans have been formed, and are being executed, to arrange our construction at Nashville and Memphis for double our present number of subscribers, with good prospects of securing same within a reasonable period. We could not, the first few months, charge to its proper month each month's expenses; but from tables given below you will note that, for the first five months the expenses were about 60 per cent., while for the last five months they were about 53 per cent., and in future, we think, they will not exceed 50 per cent., and may go below that figure.

An unprecedented flood in the Ohio Valley during January and February cut down our revenue for February fully seven hundred dollars, and increased our expenses nearly as much more.

The following is a statement of earnings and expenses for the past ten months:

	RENTAL.	TOLL LINES.	TOTAL EARNINGS.	EXPENSES.
June, 1883	$7,630 57	$2,969 63	$9,900 20	$5,638 05
July	9 384 11	2,983 62	11,767 73	4,019 75
August	9,521 18	2,615 79	12,136 97	7,633 55
September	9,852 68	2,734 85	12,587 53	9,779 52
October	10,387 95	2,531 23	12,769 18	7,926 73
November	10,776 78	2,775 05	13,551 83	7,308 25
December	11,102 27	2,985 18	14,086 45	9,227 60
January, 1884	11,709 29	2,724 73	14,434 02	7,110 37
February	11,574 89	2,505 70	14,080 59	7,995 08
March	12,490 17	1,951 39	15,041 56	7,998 88
Total	$103,879 89	$26,476 17	$130,356 06	$72,537 78

Comparing March, 1884, with June, 1883, we have an increase of $5,141.36 in gross earnings, or over fifty per cent. in ten months, while the expenses show but eleven per cent., or $745 10 over the average expenses for the ten months.

Net earnings for ten months		$57,818 48
Dividend No. 1, paid October 1st, 1883, 1½ per cent	$15,295 50	
Dividend No. 2, paid January 1st, 1884, 1¾ per cent	17,848 25	
Dividend No. 3, paid April 1st, 1884, 2 per cent	20,400 00	
		53,543 75
Balance to credit income account		$4,264 53

The earnings for April, 1884, show the same steady increase, and May has every appearance of continuing it.

Respectfully submitted,

E. S. Babcock, Jr.,
President.

Providence Telephone Company.

Providence, R. I., May 26, 1884.

To the Editors of the Electrical Review:

Thanks for the gratuitous advertising which you are allowing to be done in these columns. Our Providence system stands on its merits; but I am sorry to see that our critics are not familiar with its details, and am inclined to think that they never have had active participation in active telephone work. As you decline to give their addresses, I have no other way to reach them than through you, and must beg your indulgence for this last time.

In reply to the article in your issue of May 10th, I think the rates do have some effect in increasing the number of subscribers of the Providence Exchange; but if the service were notoriously bad, or even barely endurable, it is fair to suppose that neither subscribers nor endorsement of the service would come to us. We receive, however, but few complaints, and many emphatic praises from our patrons. At this writing the additions for the present month have been eighty-five, and there are twenty-eight unfilled applications on file, seven of which latter came in to-day. The increase of the present year bids fair to exceed that of any year. Apparently the system advertises itself to those who live here and understand its use. Would it not be better, then, to say that low rates *and good service* have built up the Providence Company?

I am unable to understand the reference to the use of and abandonment of the Providence system in other exchanges. No large exchange has tried the system as it is worked in Providence, nor could it be used for over 1,500 or 2,000 subscribers with any pin switchboard except the Breckenridge board, which is in use in Providence. The Post, Williams and Gilliland boards have been discarded in other large exchanges, and the multiple board substituted, because the former could not do the work. The Breckenridge switchboards furnish 200 cross-connections in smaller space than is taken by fifty bars on the Williams or Post board, and are ample for an exchange of 4,000 wires, with all the working parts easily accessible to the operator without leaving her chair. Can any multiple board do more? The multiple system is unquestionably excellent in an exchange of special lines, or where there is general uniformity in the styles of lines and instruments, but is not adapted to the economical introduction of novelties from time to time without modifying the system to meet the special case. One or two lines of peculiar character introduced into a multiple system would necessitate the expense of the peculiar feature at every section, or of changing the ordinary routine for the special case. This is evinced by the fact that for the trunk lines the multiple system departs from its routine, and uses a modification of the Providence system, in that it requires two operators to attend to the work.

Unfortunately higher prices cannot be obtained in many cases, and it is policy to arrange prices and means which will popularize the telephone, give the public, as may be desired, the benefit of improvements, and at the same time render a profit to the company. The Providence system apparently does this. Where is the multiple system now operated in an exchange having, as is the case with us, seven different styles of line working together without confusion, and ready to test any novelty without altering the general plan of the system for the special case?

I think I have previously stated my opinion that it is desirable to designate subscribers by numbers when the relations of the wire and subscriber are liable to be unchanged, and in a system of separate wires for each subscriber should unhesitatingly adopt numbers at the outset. Why it has not seemed best to adopt numbers here is shown by the fact that during the past year 625 new subscribers have been connected in; but in doing this we have been compelled, for economical considerations, to change the wires by cross-connecting, dividing into sections, rebuilding, etc., of more than 200 old subscribers. Furthermore, 230 subscribers have changed their locations during the year, all of which would have entailed a change of over 500 numbers to correspond with the wires, etc. It seems to me that this would entail a great deal of confusion upon the subscribers, which we can well avoid now by a little extra care on the part of the operator. Unquestionably the time will come when a numbered system, or something better than that even, will be adopted

I am fairly familiar with the multiplex system, in its various stages, for two years past, and as now working in Baltimore and New York, and believe the following figures are sufficient answer to the final paragraph in the article under reply: Providence (population 120,000), with 2,100 subscribers (with free use of 45 trunk lines, connecting eight exchanges within a radius of fifteen miles, containing 2,800 subscribers), employs 26 operators during the day, and of these six are employed on trunk lines. Baltimore (multiplex system), with about 1,500 subscribers (two trunk lines) employs 19 operators. But the cost of the two systems to the exchange is beyond comparison. The Breckenridge switchboards used in Providence are supplied in sections of fifty wires, costing not over $5 a line, with no royalty, and guaranteed to 4,000 lines without any change other than the necessary additions of fifty-wire sections as fast as required. The multiple board, I understand, with about the same expense of maintenance and operation, costs about the same per line, with a substantial annual royalty for each subscriber.

I dwell on this point of comparative expense as still further explaining why the Providence exchange has progressed so rapidly. The machinery has been supplied at low cost, and gradually, which enables the exchange to be equipped and maintained at small expense, and a profit to be derived

from low prices. Low prices, and apparent satisfaction of subscribers with the facilities given them, have attracted additional patrons, and are still doing so faster than ever. I shall be pleased to know if there is an exchange of over 2,000 subscribers in one room with a like record, or more economically operated and maintained. In my opinion the perfect switch-board has not yet been attained. The multiple switchboard and the Providence system are both excellent, but in different directions. The multiple board, though possibly the quickest, does not well admit of tariff line service or the use in consecutive order of a busy line without changing its routine. The Providence system does all its work, without exception, in regular routine, and has capacity greater than the multiple board in the same space. Both systems are good, and both can be improved.

I hope our critics will throw off their masks, and if an opportunity offers, examine our system personally before criticising further. I shall be happy to entertain them at any time, and am always glad to receive suggestions which may be of benefit to the service. J. W. DUXBURY.

Female Telegraphists in England.

It is now thirty years ago that women were first admitted into the telegraph office. The story goes that the Queen herself has done much to promote their admission. Gen. Wylde, one of the directors of the Electric International Telegraph Company, and in 1853 equerry to Prince Albert, is said to have suggested the idea to her Majesty, who at once entered into the plan with much sympathy. The experiment was begun with only a few girls, but their number has so steadily and, since in 1870 the telegraphs were bought up by the Government, and even more since Mr. Fawcett has become Postmaster-General, so rapidly increased, that at present no less than 659 women are employed at the Central Telegraph Office in London, and about 350 more at the different telegraph and postal branch offices of the metropolis. At Liverpool, Glasgow, Manchester and, other provincial centers, a considerable number earn their living in this branch of the civil service, and besides these there are 900 women similarly employed outside the civil service.

Of the women at the Central Telegraph Office, 424 are second-class telegraphists, receiving weekly pay of 10s., 12s, and 14s., rising by 1s. per week per annum to 17s., and then by 1s. 6d. a week per annum to 27s. Of first-class telegraphists there are 196, with a salary of 28s., rising by 1s. 6d. a week per annum to 34s.; 15 assistant supervisors receive £90, and rise by £5 per annum to £110; 15 others receive a salary of £110, rising by £6 per annum to £140; the 8 supervisors receive £150; 6 of these rise by £8 per annum to £180, the 2 remaining ones to £235. The matron receives £150, rising by £10 per annum to £250.

The daily work of the female telegraphist extends over eight hours, within the period of from eight in the morning to eight at night. If they work ten hours per day one week, they only work six hours a day the week after. No telegraphist is allowed to leave the premises between the working hours, but as dinner is served in the spacious dining rooms, two of which belong to the women and two to the men, and as breakfast and tea are provided for the whole staff employed at the General Telegraph Office, this is no troublesome regulation. The tea is brought round to the desks by a special staff of twenty-four female servants; the cost of this "afternoon cup of tea, with a couple of slices of bread-and-butter," amounts to no less than £1,500 pounds per annum. Breakfast for the early comers and tea are provided free of cost. It occurs occasionally that the female telegraphist has to do Sunday work; night work she is never expected to do, "for," reasons the head of the institution, "no respectable mother would like her daughter to be out alone after eight at night or before eight in the morning, and consequently we should have a lower class of girls than is at present the case."

To judge from appearances, the present female staff are girls and women of a very superior class. They work in large rooms, at present mixed with the men; sometimes a single female telegraphist amid a number of men, sometimes *vice versa*. All are busily intent on their work. Neatly attired, often with a vase of spring flowers by their side, there is an air of vigor and sprightliness about them which harmonizes well with the busy scene of which the women telegraphists form by no means the least attractive feature. But notwithstanding bright looks and rosy cheeks the report of their state of health, as compared with that of their male colleagues, is not very satisfactory. Long absences, caused by serious illness, are rare, but the frequent occurrence of an absence of a day or two is one of the chief disadvantages of the employment of women in the telegraph office. "Of course," says Mr. Fischer, "they are differently constituted from men, and for this we make due allowance, but experience has taught us that in many cases the absence is due only to a want of energy. They seem to be unable to rouse themselves when sometimes overcome by a feeling of languor. The mothers, too, are, no doubt, often to be blamed for encouraging their daughters to stay at home. We cannot depend on the women in this respect as we can on the men." One-third of the wages is deducted on an absence from a day to six months, but they seem well content with this arrangement.

It happens now and then that members of the staff marry, but more frequently they marry outsiders. Of the thirty-three resignations which occurred in the female department in 1883, most were caused by marriage—an event which invariably causes female telegraphists to resign their appointments. The superannuated receive a pension; if they have been employed for less than ten years, they are paid off with a certain sum according to the number of years of their employment; those who have been employed for a longer period of time receive a pension of a sixtieth part of their wages for each year of their employment.

Western Union's Official Statement.

The official statement of the Western Union Telegraph Company for the year ending Dec. 31, 1883, shows gross revenues $19,571,476.41; expenses (including all expenses of operating, maintenance, reconstruction, taxes, rent of leased lines, etc.,) $12,928,963.14; net profits, $6.642,513.27, from which there was paid for four quarterly dividends of 1¾ per cent. each, $5,539,125.43; interest on bonded debt, $426,247 30; sinking funds appropriation $40,094; surplus for the year $577,046.54. It is probable that the W. U. Telegraph Co.'s dividend will be reduced from 7 to 6 per cent. at the next meeting of the board of directors. It is stated semi-officially that the average earnings of the company are abundant to pay regular dividends, but the constant purchase of intersecting and subsidiary lines, the construction of new lines and the maintenance of those in operation, together with the erection of two new telegraph buildings in New York, the laying of pneumatic tubes, etc., have required so large an outlay that it is thought wise to leave as much of the surplus earnings intact as possible to meet expenses of this kind, and with that in view a change of 1 per cent. in the dividends has been contemplated. The more conservative element in the directory has always deprecated a larger dividend than 6 per cent. The company furnishes a table showing the number of shares of stock in brokers' names and in the names of investors, as under:

	Shares in brokers' names.	Shares in investors names.
At close of company's books, Sept. 20, 1881	391,054	408,496
At close of company's books, Sept. 20, 1882	300'247	499,753
At close of company's books, Sept. 20, 1883	261,043	588,957
At quarter ended March 30, 1884	216,658	583,342
At week ended May 17, 1884	181,793	618,307

Since March 20 last the number of stockholders has increased from 2,940 to 3,220, a gain of 280.

Defeat for Western Union.

A DECISION AGAINST IT IN A SUIT AGAINST THE BALTIMORE AND OHIO COMPANY.

Chief-Justice Waite, on Saturday last at Baltimore, filed his decision in the case of the Western Union against the Baltimore and Ohio Company, which has been pending for a number of years in the United States Circuit Court for Maryland. The Western Union, as the successors of the old Western Telegraph Company, claimed the telegraph lines erected under a contract between the Baltimore and Ohio Company and the Western Telegraph Company in 1855, from Baltimore to Wheeling and Parkersburg. The Baltimore and Ohio Company contended that the contract had expired, and that the Western Union Company had no right upon its line of road, and that the Baltimore and Ohio has been in complete possession and operation of this line of telegraph since 1877. The court upholds the position taken by the Baltimore and Ohio Company, giving to the Western Union simply the value of one wire, which was tendered to it by the Baltimore and Ohio Company at the time of taking possession of the lines in 1877.

This is a very important decision, and is another victory for the Baltimore and Ohio Telegraph. Dr. Green, president of the Western Union, testified before a Congressional committee the past winter that his company was the owner of the lines on the main stem of the Baltimore and Ohio road, and that was the contention of the Western Union in the suit just decided; but the opinion of the Chief-Justice settled the point against the Western Union, and leaves the Baltimore and Ohio in possession of the field.

A Feat of Telegraphy.

We have often heard of the wonderful line between this country and Teheran, the capital of Persia, a distance of 3,800 miles, but we scarcely realized the fact that good signals were obtainable through so great a length of wire until recently, when we availed ourselves of an invitation from Mr. W. Andrews, the managing director of the Indo-European Telegraph Company, to make a visit of inspection. It was between seven and eight on Sunday evening, April 13, when we reached the office.

In the basement of an unpretentious building in Old Broad street, we were shown the Morse printer in connection with the main line from London to Teheran. The courteous clerk in charge of the wire, Mr. Blagrove, informed us that we were through to Emden, and with the same ease with which one "wires" from the City to the West End we asked a few questions of the telegraphist in the German town. When we had finished with Emden, we spoke with the same facility to the gentleman on duty at Odessa. This did not satisfy us, and in a few seconds we were through to the Persian capital, Teheran. There were no messages about, the time was favorable, and the employes of the various countries seemed anxious to give us an opportunity of testing the capacity of this wonderful line.

T. H. N. (Teheran) said, "Call Kurrachee," and in less time than it takes to write these words, we gained the attention of the Indian town. The signals were good, and our speed must have equaled fifteen words a minute. The operator at Kurrachee, when he learned that London was speaking to him, thought it would be a good opportunity to put us through to Agra, and to our astonishment the signals did not fail, and we chatted pleasantly for a few minutes with Mr. Malcolm Khan, the clerk on duty. To make this triumph of telegraphy complete, Agra switched us on to another line, and we soon were talking to a native telegraphist at the Indian Government Cable Station, Calcutta. At first the gentleman "at the other end of the wire" could not believe that he was really in direct communication with the English capital, and he exclaimed, in Morse language, "Are you really London?" Truly, this was a great achievement. Metallic communication without a break, from 18 Old Broad street, London, to the telegraph office in Calcutta! Seven thousand miles of wire! The signals were excellent, and the speed attained was not less than twelve, perhaps fourteen, words per minute.—*Telegraphist.*

TELEGRAPHIC

... Spain has but 800 telegraph stations, although there are 2,803 places with a population exceeding 1,000.

.... The New York *Herald* avers that with the Bennett-Mackey cable laid, the ocean telegraph monopolists have an opposition which has come to stay. We shall see.

.... The convention between France and Spain for the laying of the cable between the Canary Islands and Senegal, was signed on Friday, the 2d inst., by M. Ferry and Señor Silvela, the Spanish Ambassador.

.... As the result of some very careful tests recently made, it is estimated that an electric dot travels at the rate of 16,000 miles per second, or 9,600,000 miles per minute. This is not quite up to the speed of light, which travels 12,000,000 miles per second.

.... At the annual election, on May 27, of the New York Mutual Telegraph Company, the following-named gentlemen were chosen directors: John G. Moore, George F. Baker, George S. Scott, H. C. Fahnestock, Jay Gould, Russell Sage, George William Ballou, George G. Haven, George J. Gould, and C. F. Peck.

.... There are eight cables across the Atlantic Ocean now in use, which cost $64,400,000; four belonging to the Anglo-American Company, which cost $35,0 0,000; two owned by Gould's company, which cost $14,000,000; one owned by the Direct United States, which cost $7,000,000; and one owned by the Pouyer-Quertier Company, which cost $8,400,000. Another, the Bennett-Mackey, is now being laid, and a live competition in ocean telegraphing is in prospect.

. .. Notice has been given that an application will be made for a charter for the Western Pennsylvania Telegraph Company. The territory covered by the company will be Greene, Washington, Beaver, Lawrence, Mercer, Venango, Butler, Allegheny, Westmoreland, Fayette, Somerset, Indiana, Armstrong, Clarion, McKean, Elk, Jefferson, Clearfield, Cambria, Blair, Bedford, Centre, and Cameron counties. The incorporators are employes of the Baltimore and Ohio Telegraph Company.

.... The Great Northern Telegraph Company, of Copenhagen, which held its meeting at the Danish capital, has now seventeen with a total length of 6,162 nautical miles. It was mentioned as an illustration of the extent to which political events affect the receipts of telegraph companies, that last year they had earned £30,000 more than in 1882, owing to the exceptional correspondence caused by the Franco-Tonquin war. Judging from all appearances, the Eastern Telegraph Company ought to expect considerably increased business this autumn on account of the threatening aspect of affairs in Egypt.

.... The New York *Herald* people now positively state that their first cable will be completed and in good working order by the middle of July, and they just as positively assert that they will give the public the universal rate of threepence a word on all messages, notwithstanding the threats of the cable pool to cut below a living rate. Preference will be given to full-rate messages in the order of their filing. Outside press messages, that is, press messages other than those addressed to the New York *Herald*, will come next, and will probably be carried at some reduction from the full rate. Dispatches filed for the *Herald*, excepting possibly those of an urgent character, will then be transmitted, taking the third or last place in the order of precedence. In other words, the *Herald* proposes to utilize the cable when everything else is clear to its fullest extent. They will see that the wire shall not know an idle moment. Their operators will work night and day, unceasingly, and when the revenue from outside sources lets up for no matter how short a time, the *Herald* will jump in and derive all the benefit it can from what would, under ordinary circumstances, be a dead loss.

ELECTRICAL AND SCIENTIFIC

* * The tensile strength of glass has been shown to be between 2,000 and 9,000 pounds per square inch, and the crushing strength between 6,000 and 10,000 pounds per square inch.

* * St. Louis is getting excited over the matter of poles in the streets, and makes the very reasonable demand that as many wires as possible shall be put on each, so as not to unnecessarily multiply the number of poles.

* * Five cells of the new Thame battery are said to have power to run five Swan lamps of five candle-power each for fifty hours, without renewal. It is said to consist of zinc in sulphuric acid, and carbon in chlorochromic acid, separated by a porous cup.

* * Descending into the bowels of the earth, it is found that the temperature increases at the mean rate of one degree for every forty-five feet. At this rate water boils at the depth of six miles, while at the depth of sixty miles the hardest rocks known to geologists are in a molten state.

* * A gold medal has been awarded by the Paris Geographical Society to M. Desire Charmay, for his Central American explorations, and especially his researches in Yucatan. The great gold medal of the society was awarded to the deep-sea expeditions of the Talisman and the Travailleur.

* * A luminous water-proof paper, which may be of use in places not well adapted for the application of the so-called luminous paint, may be made from a mixture of forty parts pulp, ten parts phosphorescent powder, one part of gelatine, one part of potassium bichromate, and ten parts of water.

* * An invention is now being exhibited by Mr. Ferguson in Lombard Street London, with which, it it is said, he claims to produce light and electricity from chemicals, which, after being used, are worth £5 per ton more than in their original state. The principal materials used are caustic soda and zinc. They are not too modest in their claims, to say the least.

* * Joseph Bazalgette's compiled statistics about the water supply of the chief cities of the world show the following per capita distribution: Rome, 160.35 gallons per head a day; Marseilles, 168.4; Washington, 143; Chicago, 102.5; Boston, 73.3; New York, 60.5; Philadelphia, 54.15; Hamburg, 44.5; Paris, 36; London, 31; Berlin, 13.3.

* * Messrs. de Meuron and Cuènod, of Geneva, Switzerland, have just completed the installation of a very important electric power plant in Biel. A water-power of 30-horse is transmitted a distance of 4,000 feet through a copper wire. The dynamos are of the Thury pattern, revolving at the rate of 400 to 500 times a minute.

* * The *Moniteur Industrielle* gives the composition of an artificial gutta-percha as follows: Fifty parts by weight of copal and 7.5 to 15 of sulphur, with 15 to 30 of turpentine, or 55 to 60 of petroleum; mix well; heat to 100° C., until completely dissolved; let cool to 35°; add a solution of 3 parts of caseine in weak ammonia and a little methylene; re-heat to 120° until of weak consistency; then boil with a 15 to 20 per cent. solution of tannin and about 15 parts of ammonia. After several hours' boiling wash and cool.

* * The conductivity of aluminum, according to recent tests, is but about one-half that of copper; in other words, its resistance as compared with that of copper is as 1.96 to 1, for the same dimensions. But, owing to the extreme lightness of aluminum, in conductors of equal length and equal weight, it is found that the conductivity of aluminum is somewhat superior to that of copper. This property renders it very desirable as a conductor in military telegraphy, in which lightness is an important consideration. But it is also true that, in military operations, compactness is a very important consideration, and this is certainly in favor of copper.

* * A new application of the electrical transmission of energy has been working regularly and very successfully for some months past in a coal mine in the neighborhood of Vienna. The two dynamos employed are Gramme machines; the generator gives a current of 15 amperes, with an electromotive force of 500 volts. The receiver produces about 8 H. P., at a distance of 1,900 meters, and actuates a pump, which delivers 300 liters of water per minute at a height of 60 meters, and through a conduit 800 meters long. Before the adoption of the electrical machines a steam engine was used, the radiating heat from which rendered it very uncomfortable to remain in the gallery. The employment of dynamos has caused the temperature to fall about 14 degrees. It is also said that the consumption of fuel is considerably reduced.

* * The extraordinary vagaries of the descent of an electric current into a coal mine in the vicinity of Bolton, England, have just been made known. Not long ago, during a thunderstorm, the lightning first struck the chimney at the top of the up-cast shaft at the pit in question, displaced a large quantity of brickwork, and descended outside the chimney, striking the ground close to it, and making a large hole. The current then passed along the ground to the cast-plates at the top of the down-cast pit, and, it is presumed, was conducted down the steam pipes, and so into the workings. The shock affected the manager so seriously that he was prostrated for about a week, and a miner, who happened to be standing about a foot away on a tram rail had his clog scorched as if hot iron had passed over it. How the electric current finally escaped, or where it spent itself does not appear.

* * If what was put in a crucible came out of it, says the *Age of Steel* in an article on "Brass Castings," there would be less diversity in results. What with the volatility of some metals and the varied melting point of others in the same mix, it is wonderful that anything like uniformity can be obtained in ordinary work. Zinc sublimes—burns away—at 773° to 800°, while the heat of the metal with which it should be intimately mixed in making yellow brass—copper—is nearly 2,000°. Zinc, tin, and lead enter into compositions of copper to form alloys in varying proportions—always in definite quantity—for a given alloy. It will be seen, therefore, from the ease with which the lesser metals are burned away at comparatively low temperatures that it is a very easy thing to make several kinds of metal out of the same mix. The *Engineer* adds the fact, too well known to amateurs, that copper often manifests a remarkable proclivity for leaving the casting house, which further complicates the question.

* * Dr. G. Gore, F.R.S., has invented an improved thermopile for measuring small electromotive forces. It consists of about 300 pairs of horizontal, slender, parallel wires of iron and German silver, the former being covered with cotton. They are mounted on a wooden frame. About 1½ in. of the opposite ends of the wires are bent downwards to a vertical position to enable them to dip into liquids at different temperatures, contained in long, narrow troughs; the liquids being non-conductors, such as melted paraffin for the hot junctions, and the non-volatile petroleum, known as thin machinery oil. The electromotive force obtained varies with the temperature; a pile of 295 pairs, having a resistance of 95.6 ohms, at 16 deg. Cent., gave, with a difference of temperature of 100 deg. Cent., an electromotive force of .7729 volts, or, with 130 deg. Cent., an electromotive force of 1.005 volt. Each element, therefore, equaled .0000262 volt for each degree Cent. difference of temperature. On having been verified with a standard voltaic cell the apparatus becomes itself a standard, especially for small electromotive forces. It is capable of measuring the $\frac{1}{3333}$ part of a volt. For higher electromotive forces than a volt, several of these piles would have to be connected in series. The fractional electromotive force is obtained by means of a sliding contact, which cuts out so many pairs as is required.

* * Simplicity is an obvious characteristic of the New Forest gas motor. It consists of a cast-iron base, to which are bolted two standards supporting a cylinder cast in a piece with a helix to present a very large cooling surface to the surrounding air, and so rapidly reduce the temperature of the cylinder when heated by successive explosions of gas. In the cylinder is adjusted a piston, which is connected to a rocking lever jointed at the lower extremity to the cast-iron base, and oscillated by means of the piston rod. This lever sets in motion the driving shaft with which it is connected by a rod and crank. The driving-shaft rests upon two pillow blocks, cast in a piece with the front plate of the cylinder, and is provided with a cam to act upon a distributing slide-valve, which carries a roller at its extremity. This valve, which is thrust forward at every revolution of the fly-wheel, is brought back to its original position by the pressure of a spiral spring. The gas for actuating the engine enters, through a pipe, the ports of the valve seat, which is also furnished with ports for the entrance of the air. The gas and air, mixed in the hollow part of the valve, are afterward distributed in the cylinder, where they are inflamed by the burner fixed to the side of the slide-valve, and become ignited by another burner at every stroke of the piston. To permit of regulating the admission of the air according to the speed of the engine the valve-seat is provided with a movable plate containing small vertical apertures, which is adjustable at will in a horizontal direction, so as to partially cut off the air-ports. The escape takes place through a pipe which forms a connection with the interior of the distributing slide-valve.

The Atlantic Cable Alliance.

The existing Atlantic Cable companies are reverting to the old-fashioned policy of a combination amongst themselves for the destruction or absorption of any fresh competitor. This new banding of an old alliance is to-day directed against the Bennett-Mackey enterprise, whose cable lines are approaching completion, and whose appearance is regarded as an impertinent intrusion by those already in the field.

These latter argue that they possess the means of transmitting three hundred thousand words a day. The actual business, however, is confined to within a tenth of this quantity, in consequence of the high rates levied by this monopolistic combination. At present there are three tariffs in force, the general charge of fifty cents per word for commercial and cipher messages, including addresses and signatures, and the press rates. Of these there are two, one of twenty-five cents per word for expedited messages, and a twelve and a half cent rate. The latter toll is collected on "deferred press messages," that is, despatches filed to be sent at the convenience of the companies. As despatches intended for the press are generally marked "rush," and filed for immediate delivery, the deferred rate is practically ignored. All the press associations have labored in vain for a year past to secure a uniform press rate of twelve cents per word, and a uniform commercial rate half that of the present. It has been repeatedly demonstrated that if the present tolls were cut down one-half the cable business would be trebled, and the line kept busier at no increased expense but with largely increased returns. The pool has always sneered at these assertions, however, but they at length practically recognise their truth.

During the present week it has been announced that the combination has agreed to open the competition with the Bennett-Mackey cable by establishing a uniform rate of threepence, or six cents, per word on all business filed on the pool lines. No reduction in the present high charges, it is said, will be made until the new line is in active operation, which, it is contended, cannot be for several months yet. The pool managers assert that the Bennett cable will not attempt to do business at a lower rate than threepence per word, and say they will meet it in any reductions it dares to make below that price. There is probably quite enough capital behind this Bennett-Mackey enterprise to maintain a successful war even with so powerful a combination. It is generally understood, in fact, that it was called into existence for the express purpose of fighting it to the last, if necessary; at all events, to introduce a very low tariff of cable charges and to maintain it at whatever cost.

Unfortunately, however, the public has heard all this kind of talk not a few times already, and so far it has always ended in the fraternization of these apparently irreconcilable enemies and the recommencement of the plucking of the public goose. We shall be agreeably disappointed if the farce is not once more repeated in the case of this enterprise, though we would fain hope for the best.—*The Shareholder.*

Russell's Improved Process for the Lixiviation of Silver Ores—With Critical Remarks on Other Methods of Copper, Silver, and Gold Extraction.

By C. A. Stetefeldt, New York City.

THE ELECTROLYTIC PROCESS.

In Europe the tendency is, at present, very much in favor of the electrolytic process. The complete separation of the precious metals, and the great purity of the electrolytic copper, provided the process is conducted with the necessary precautions, are strong arguments in its favor. First successfully introduced in England, it has been in operation for several years on the continent, especially in Germany. The principal works there are those at Hamburg, Oker, and near Eisleben. The details of the process are everywhere guarded with the utmost secrecy, and admission to the works is generally refused. No literature of any value from a technical stand-point exists. Professor Hampe, of Clausthal, so well known to metallurgists through his researches on copper, after investigating the electrolytic process in a most thorough manner, had written an exhaustive treatise bearing on all practical questions. Its publication was officially suppressed. Such bureaucratic folly still exists in Prussia. If officers of the government are allowed to act in such a mysterious way—this takes us back to the times of the alchemists—we can not expect that a firm in Hamburg should be more liberal. This spirit of narrow-minded illiberality is fast gaining ground in the metallurgical works of Germany, and wherever the student goes, he is no more received with the cordial frankness of former times. Even the Ziervogel extraction-works of the Mansfeld Company are now closed to visitors, simply because the general manager was, at some time, refused admittance to silver extraction works in Swansea. But are there, in fact, such awful secrets about the electrolytic process as this policy would indicate? And is it surrounded with such enormous technical difficulties as all the managers of European works seem to imply? My answer is in the negative. That these gentlemen have finally achieved a great success, after a long series of blunders, nobody will deny. But it seems to me they would have reached their goal much sooner, if they had paid a little more attention to well-established laws of electricity. That the working of copper matter, by this process, proved to be a failure might have been anticipated beforehand. The notion that any copper, no matter how impure, could be treated by it with economy might also have been condemned in advance. The electrolytic process permits the use of currents of low intensity only. With increased differences in the composition of the electrodes, the difference in their electric potential also increases, and a marked polarization of the current must be the result. But perhaps of still greater importance is the durability of the copper solution in which the electrodes are immersed. Certain impurities concentrate in this solution more and more, and are finally precipitated on the cathode. The peculiarity of arsenic to precipitate the sooner on the cathode, the lower the electric current is in intensity, was also known to physicists before it made itself felt

in electrolytic works. That the process does not offer great technical difficulties, or require an experience of several years, has been demonstrated by its successful introduction at the metallurgical works of Mr. Balbach, Newark, New Jersey. The plant, of 800 pounds daily capacity, is by no means a model of construction, but it works well and with profit. Mr. Balbach claims no secrets, and admits with pleasure every body belonging to the profession.

There is no doubt that the electrolytic process offers many advantages compared with other processes, both in economy and perfection; but the large capital required for the plant and buildings, the extensive area covered by the latter, and the enormous quantities of metal in rotation are a bar to its introduction on a large scale. In this country, especially, capitalists are not inclined to invest so much money for such purposes. Hence it is a question whether it can compete with those processes which are based upon the regeneration of sulphuric acid, and require a comparatively inexpensive plant.

The Western Union Wire Fence Company, the Missouri Wire Fence Company, and the St. Louis Wire Fence Company have been merged into one company, under the name of the Western Union Wire Company. The new concern has a paid-up capital stock of $100,000. The new company is licensed by the Washburn & Moen Manufacturing Company for a maximum production of 10,000 tons of wire yearly, and it is its intention to manufacture to the extent of the limit. The works are established in the buildings previously occupied by the Western Union Wire Fence and Missouri Wire Fence companies.

The American Association for the Advancement of Science.

Prof. Thurston has given notice of the Philadelphia meeting of the above society Sept. 3 to 10, 1884. The objects of this association are the advancement of all sciences most directly applicable to the arts and in the departments of engineering, civil, military, mining, mechanical and electrical. Members of every related profession will be heartily welcome.

Parties who intend presenting papers can obtain the proper blanks from the secretary, J. Burkett Webb, Cornell University, Ithaca, N. Y. An effort is to be made to carry out the idea proposed at the Minneapolis meeting, to invite persons interested in mechanical science to join the association and take part in the proceedings of Section D at the Philadelphia meeting. Parties desiring information with reference to this, will address Prof. R. H. Thurston, Stevens Institute of Technology, Hoboken, N. J.

Engineers Warned of Danger.

A novelty in the way of electric railroad signals is shown by a working model at 24 Congress street, Boston, Mass., and is well worthy the attention of railroad managers. There are several systems of electric signals for protecting trains from danger, and the "block system," by which the road is divided into sections, each complete in itself, and having its danger signals scattered along the road at certain points, is one of the most perfect. All these systems, in a measure, however, depend upon the eyesight of the engineer of each train for their effective working, and in case of a blinding snow storm, or an impenetrable fog, the engineer may be unable to see the danger signal in time to stop his train before it crashes into another train, or is thrown from the track by some obstruction. By the invention now under consideration, no matter how thick the snow storm or how dense the fog, the engineer is told in his cab whether the track is clear or not. The apparatus consists of a generator of electricity placed on the engine, and connected with the rails by a suitable device to convey the electric current to the generator. In the cab, over the head of the engineer, is placed a gong and target, which works as follows: When a train is entering upon a section of road, if the tracks are all clear, the rails all in place, the switches and drawbridges all closed, the gong will ring a safety signal; but should there be a train or hand-car or any other obstruction upon the track, a switch or drawbridge open, the gong will strike a danger signal and the target will appear before the eyes of the engineer, upon which are the words "Danger, Stop," and this target will remain at danger until the trouble is removed, or until the entrance is made on the next section, when it returns to safety, ready for the next signal. Another most important feature is that all switches and drawbridges are locked by the train immediately upon entering the section where such switches or drawbridges exist, and cannot be opened, by the switchman or drawtender until the train has passed, so that no train can be thrown from the track by a switch being opened, after the safety signal has been given, to the engineer upon entering the section and before he can reach the switch or drawbridge.

The Determination of the Ohm.

In order to respond to the programme of the International Commission of Electric Units, we have arranged a series of experiments to determine the dimensions of the column of mercury at zero, which represents the unit of practical resistance, or the value of the ohm. In this memoir we can give merely a brief summary of the methods and the results.

The absolute resistance of a conductive circuit has been measured by the induced current which is developed when this circuit is displaced in the terrestrial magnetic-field (Weber), or when it is submitted to the action of a neighboring current (Kirchhoff). These two methods have the advantage of presenting many characters in common, and of permitting the use of the same instruments, so as to admit of a mutual control.

To eliminate systematic errors we constructed five bobbins, two of which were covered with several distinct wires, and we employed 17 different combinations, of very unequal values.

In the first method we caused to revolve in a half-circuit around a vertical axle a frame which, at the outset, was perpendicular to the magnetic meridian, observing the impulse given by the induced current to the needle of a galvanometer introduced into the circuit. The resistance is given by the expression

$$(1). \qquad R = 2\,S\frac{H}{h}\,g\,\frac{\pi}{\mu\beta}$$

in which S denotes the surface developed by the wire of the frame, H and h the values of the horizontal component of the magnetic-field at the points where are the frame and the ballistic galvanometer, g the constant of the galvanometer, *i. e.*, the action of the unit of the current upon the needle, β the angle of impulse corrected by the extinction, and μ the duration of the infinitely small oscillations, all reductions having been made.

In the second method, the induction upon the frame is produced by the inversion of a neighboring current. If we call the inducing current I, and M the co-efficient of mutual induction of the two circuits, and preserving for the other letters the same signification, the resistance of the induced circuit is

$$R = 2\,M\frac{I}{h}\frac{g}{}\frac{\pi}{\mu\beta}$$

The intensity, I, being determined by the deviation, a, of a tangent-galvanometer, of which the elements are h' g', we have

$$(2). \qquad R = 2\,M\frac{g}{g'}\frac{h'}{h}\frac{\pi}{\mu\beta}\,\text{tang. } a.$$

In order to eliminate from the formula (1) the quantities, H, h and g, we utilize the frame itself as a tangent-galvanometer, and pass into the frame and the galvanometer a common current, which gives the deviations Δ and δ. If G is the constant of the frame, we have

$$(1)'. \qquad R = 2\,S\,G\,\frac{\text{tang. }\delta}{\text{tang. }\Delta}\frac{\pi}{\mu\beta}$$

In like manner we eliminate the quantities, h, g, h' and g', from the formula (2), observing the deviations δ and δ', produced by a common current in the ballistic galvanometer and the tangent-galvanometer, which gives

$$(2)'. \qquad R = 2\,M\frac{\text{tang. }\delta}{\text{tang. }\delta'}\frac{\pi}{\mu\beta}\,\text{tang. } a.$$

The expressions (1)' and (2)' contain merely direct experimental data and the quantities, S, G and M, which are determined by the dimensions of the bobbins.

The elements, S and G, of a bobbin, with a rectangular neck, are deduced by known methods from the length of the wire, the number of coils and the dimensions of the neck.

The coefficient, M, of the mutual induction of two bobbins may be calculated by means of the elliptic integrals, according to a method indicated by Maxwell. But this calculation appears to us much simpler if effected by the use of a series developed according to the increasing powers of the ratio of the mean radii.

When, according to Weber's method, the different wires of the multiple bobbins are united either in series or in derivation, the quantities, G and S, which enter into the formula (1)', may be deduced from those which relate to distinct wires by the ordinary law of derived currents, the application of which is legitimate. We calculate in the same manner the coefficient of mutual induction of a bobbin with a single wire and a bobbin with multiple wires, grouped partially either in series or derivation.

The apparatus has been set up in the Pavilion Francais, in the Park of Trianon, which the Minister of Public Instruction and of the Fine Arts, has kindly placed at our disposal. We have thus made more than 50 complete series of observations with various combinations of bobbins, and, according to both methods, each series requiring from 2½ to 3 hours. The resistance of the circuit being compared each time with that of a standard (B.A.U.) of the British Association, their results, as the general mean—

B.A.U = 0.9861 ohm.

To find the value of this resistance in a column of mercury we constructed four tubes of about 1 square millimeter in section, and gave them such a length that when full of mercury they had the same resistance as a standard B.A.U.

These tubes had been previously graduated in parts of equal length, and calibrated with the greatest care at the International Office of Weights and Measures, by the permission and with the kind assistance of M. Broch. Each of the tubes was adjusted at its ends in vessels of glass with a large aperture, filled with mercury in a vacuum, and its resistance compared with that of a standard B.A.U at the ordinary temperature and in melting ice.

It has been experimentally proved that filling in air does not affect in an appreciable manner either the relative weights in calibration or the electric resistance.

The term of correction for the resistance at the extremities has been calculated according to Lord Rayleigh's formula. The accuracy of this formula has further been directly verified by cutting a tube into several portions, connected together by vessels with a large aperture, and determining the variations of resistance produced by each of the segments.

Closely accordant determinations for the four tubes gave:

1 merculrial unit = 0.95374 B.A.U., and consequently

1 merculrial unit = 0.9405 ohm.

Hence the length of a column of mercury at zero of 1 square millimeter in section, which represents the value of the ohm, is 1063.3 millimetres.

This results is the crude mean of the experiments without any distinction. A more careful consideration in which the experiments are selected, which appear most trustworthy, whether from the magnitude of the impulses or in general from the conditions under which the sensibilities of the two galvanometers were compared, leads us to regard the figure, 1063, as being a little too high.—*By MM. E. Mascart, F. De Nereville, and R. Benoit, in Comptes Rendus.*

ELECTRIC LIGHT NEWS

—— Gloucester, Mass., is to have a plant of Thomson-Houston half-arcs. A 50-horse power Armington & Sims engine has been ordered.

—— The Austrian Government recommends the use of electric headlights for locomotives, as a measure both of convenience and safety.

—— The City of Geneva, N. Y., has been investigating the electric light with a view to its introduction, and has decided to adopt the Brush-Swan system.

—— In the Edison light plant in the Grand Opera House, in Paris, the company was compelled by the authorities to use a gas engine, although it would have preferred steam.

—— The Hochhausen machine has been introduced into England, and a factory has been established at Halifax for the manufacture of machines and the development of the system.

—— The Edison Company has recently put 500 lights into the Bank of France, 200 into the Military School of St. Cyr, and 200 into the School of Arts and Manufactures. And yet people say that Paris has got through with the electric light. It has not fairly begun.

—— The form of electric lamp known as the Lampe-Soleil has given so much satisfaction at the South Kensington Museum (where it has been on trial for the past six months) that a two years' contract has been entered into, the light being supplied at the same cost as gas.

—— At a meeting of the directors of the American Electric and Illuminating Company, held in Boston, last week, the following officers were chosen: President and General Manager, Edward H. Goff; First Vice-President, Silas Gurney; Second Vice-President, Loren N. Downs; Treasurer and Clerk, F. Montague Sowden.

—— The German Edison Company is negotiating with the Senate of Lubec for the installation of a central lighting station in that city. The company stands ready to put in the plant, provided the use of 1,200 lights of 16 candle power each is guaranteed for five years, and a further guarantee of a monopoly of the business in the city for thirty years. It is estimated that the plant will cost the company $75,000.

—— Investigations concerning the effect of different forms of artificial illumination on the health have shown that the tallow candle is the most unwholesome agent, and the electric light the best. The incandescent electric lamp produces only about one-thirtieth as much heat as the tallow candle, while it gives out no carbonic acid or water. One gas jet in a room is said to vitiate the air as much as six persons.

—— Dr. Heammerl has devised an ingenious method for measuring the intensity of the light of electric lamps, by which the necessity for placing them at a great distance from the standard candle is avoided. He interposes a revolving disk, in which are cut out sectors, allowing only a portion of the rays to pass. For instance, if the sum of the angles of the sectors be 180 degrees, half the light will be intercepted. It has been found that three sectors are sufficient to give a uniform light with a moderate speed of rotation. Consequently, to reduce a light to a third, three sectors of 40 degrees are employed. With three sectors of 12 degrees, the light is reduced to one-tenth of its actual power. By employing two disks, each provided with three sectors of 60 degrees, cut out and arranged one behind the other on the same axis, they may be made to give as great a reduction of the luminosity as may be desired.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING MAY 27, 1884.

299,117 Construction of electric machines; Philip Diehl, Elizabeth, N. J.

299,177 Secondary battery; William Stanley, Jr., Englewood, N. J.

299,178 Secondary battery; William Stanley, Jr., Englewood, N. J.

299,206 Insulating pipe union; Charles Deavs, New York, N. Y., assignor to the Archer and Pancoast Manufacturing Company, same place.

299,288 Holder for telephone receivers; John N. Stewart, Cleveland, O.

299,300 Telephone support; Nathaniel G. Warth, Canton, O.

299,328 Electric automatic recording apparatus for weighing machines; William H. Beehler, Newport, R. I.

299,397 Electric arc lamp; Edward Jones and Albert Edward Jones, Church Terrace, Queens' Road, Battersea, county of Surrey, England.

299,417 Call-box for district telegraphs; Michael J. O'Sullivan, Baltimore, Md, assignor of three-fourths to J. Frank Morrison, same place.

299,434 Secondary electric battery; Eli T. Starr, Philadelphia, Pa., assignor by direct and mesne assignments to the Starr Electric Storage Company, of New Jersey.

299,449 Combined curbstone and telegraph wire conduit; James S. Woodward, Philadelphia, Pa.

299,467 Electric circuit connection; David E. Drake, Newark, N. J., assignor to the United States Electric Lighting Company, New York, N. Y.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $10.00. Various other Foreign patents may also be obtained.

Average Market Quotations of Battery Supplies for the Week Ending May 31st, 1884.

Leclanche Disque Cell, complete	$1.25
" Prism " "	$1.67
" Prisms, per pair	$1.00
" Carbon Mounted	30c.
" Jar Cover	12c
" Sal Ammoniac, in bag	8c
" Porous Cell	$1.10
" Glass Jar	18c.
" Amalgamated Zinc	10c.
" Rubber Bands, per pair	6c.
Chlorine Battery, per cell	$1.25
Law Battery, per cell	$1.25
" Jar and its Rubber Ring	25c.
" Cover, with small Carbon sealed in	35c.
" Large Carbons, each	20c.
" Carbon Connector	12c.
" Zinc Connector	8c.
" Rubber Bolt	12c.
" Zinc and its Rubber Ring	12c.
Bergman & Haid, per cell	$1.20
Crow foot, 6x8, per cell	75c.
Callaud Zincs	30c.
" Coppers	15c.
" Jars	25c.
Sal Ammoniac, per lb	15c
Blue vitriol, per lb	10c.
" " bbl., lots, per lb	5½c.
Sulphate of zinc	10c.
Battery syringe	$1.90c.
Battery brush	20c.
Hydrometer	50c.

Send to our advertisers for price lists.

The Toronto Electric Light Company, Toronto, Ontario, are setting two tubular boilers with the Jarvis Patent Furnace, and will use screenings and slack coal for fuel, from the slate.

Dio Lewis thinks that before the year 2,000 centenarians will be very common, and even diamond weddings not very rare. He bases his belief on the fact that during the first six months of the present year 509 persons died in Philadelphia who had lived to or beyond the age of 80, against 489 in 1882, and 449 in 1881. Moreover, he tells us that in 1816 the average length of life in Boston was 21 years; in 1874, 42 years.

BUSINESS NOTICES.

A. C. NORTHROP, Waterbury, Conn. Iron and Brass Machine Screws, Zinc in Sheets and Plate for Electrical Purposes, Parts for Telephone and Telegraph Instruments, Manufactured from Iron, Brass, Steel or Zinc.

A. G. DAY, Kerite Insulated Telegraph and Telephone Wire and Cables, Anti-induction Kerite Telephone Cables, CLARKE B. HORCHKISS, New York. Send for circular and prices.

ALFRED F. MOORE, Philadelphia, Pa. Telegraph, Telephone, Electric Light, Office, Line and Annunciator Wire.

AMERICAN BELL TELEPHONE CO., Boston, Mass. Electric Speaking Telephones for Exchange Systems, Private Lines, and Speaking-tube Lines.

AMERICAN ELECTRICAL WORKS, Providence, R. I. Patent Finished Insulated Electric Wires, Telephone and Electric Cordage. Electric Light Wire, Magnet Wire, Patent Rubber covered Wire, Aerial and Underground Cables, &c., &c. Send for prices.

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AMERICAN SPIRAL TELEPHONE WIRE CO., Boston, Mass. Spiral Telephone Wire for long and short distance Telephoning. Write for information.

ARMINGTON & SIMS, Providence, R. I. Engines for Electric Lighting and general use.

AUSTIN GALLAGHER, New York. Keith Electric Light System complete for Arc Lighting. Stock for sale.

BAXTER ELECTRIC LIGHT COMPANY, New York. The Baxter Lamp.

A. M. YOUNG, Waterbury, Conn., Leclanche Zincs. Old style of rod with new connection.

B. W. PAYNE & SONS, Corning, N. Y. The Payne Single and Double Valve Automatic Engine. Send for catalogue.

BERGMAN & CO., New York. The Bergman and Haid Battery for Telephone and Telegraph purposes. Send for circular.

BOULTON CARBON CO., Cleveland, Ohio. Carbons for Electric Light purposes. Send for quotations.

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BRUSH ELECTRIC CO., Cleveland, Ohio. Arc Lights and Brush Storage Batteries.

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DETROIT ELECTRIC COMPANY, Detroit, Mich., white oak Pins and Brackets.

D. VAN NOSTRAND, New York. Scientific Books. Send for circular.

ELECTRIC STORAGE AND LIGHT CO., Boston, Mass Own patents for Faure's Storage Batteries for territory of Rhode Island, Connecticut and Massachusetts.

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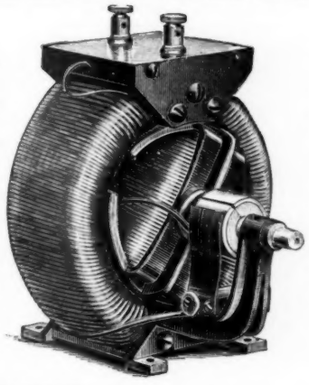

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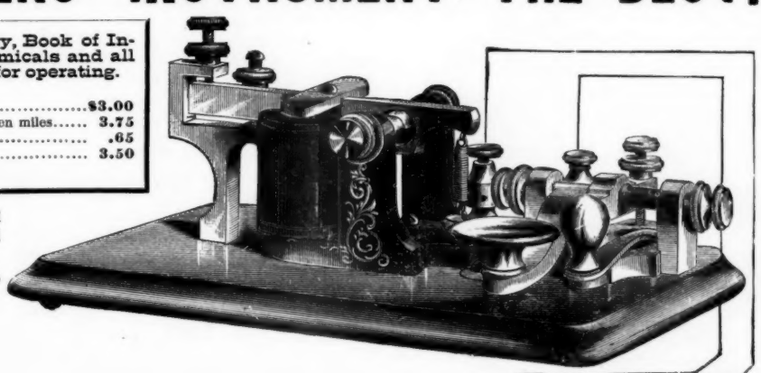

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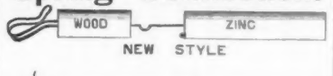

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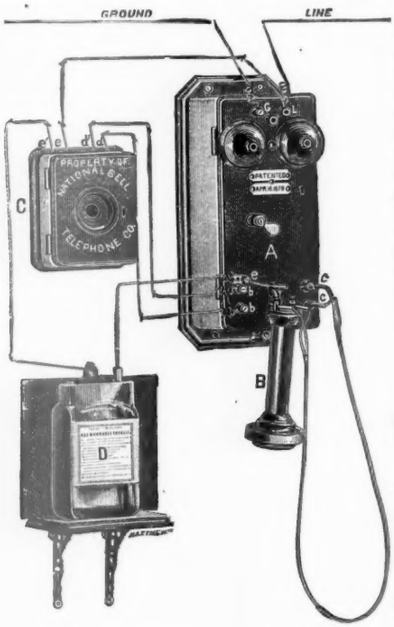

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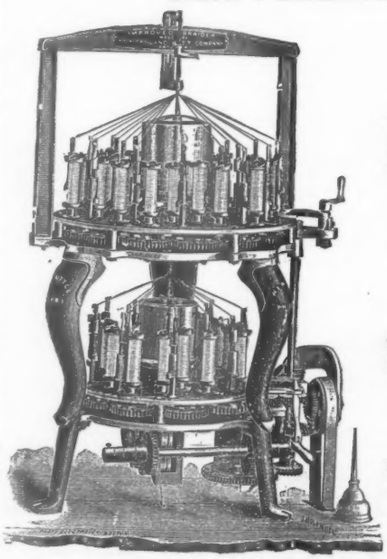

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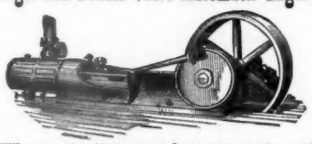

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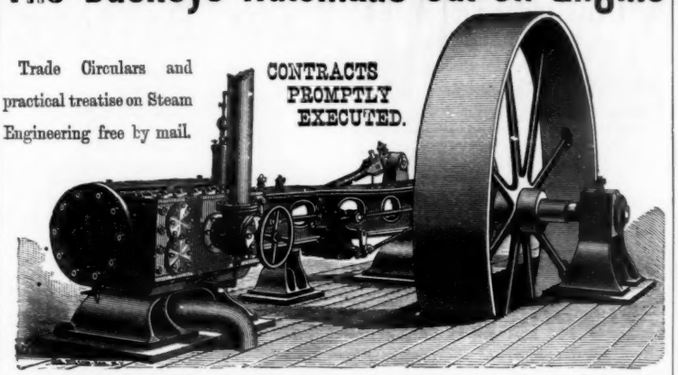

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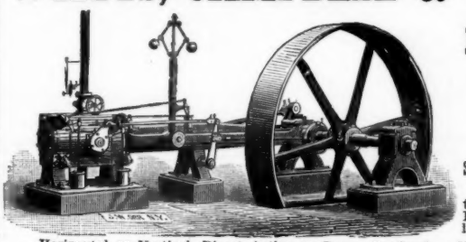

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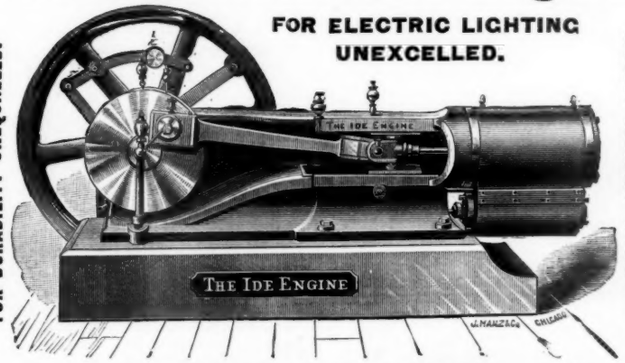

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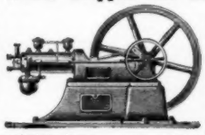

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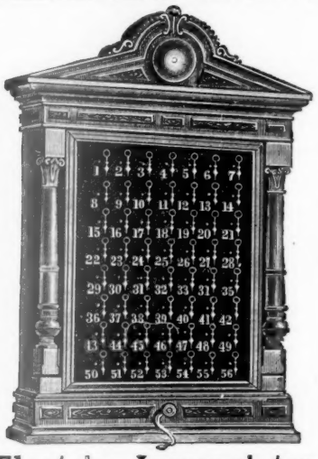

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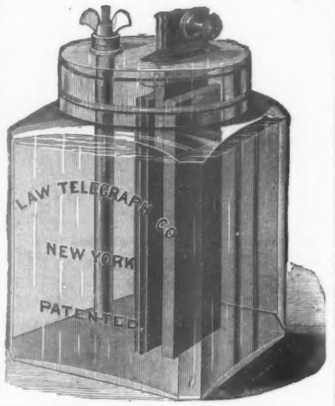

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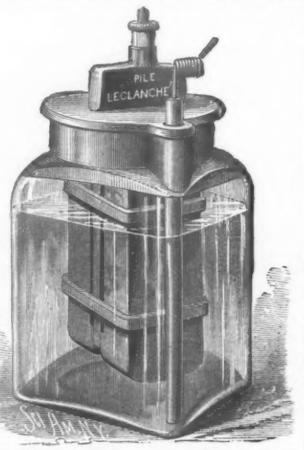

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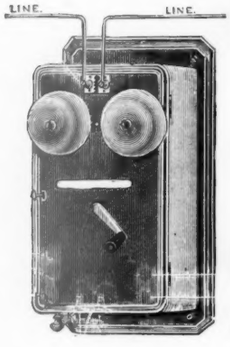

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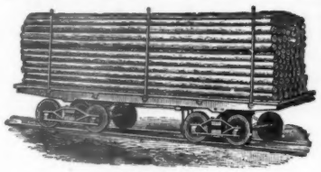

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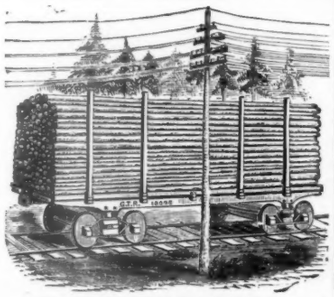

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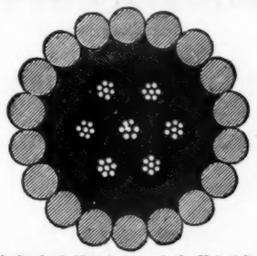

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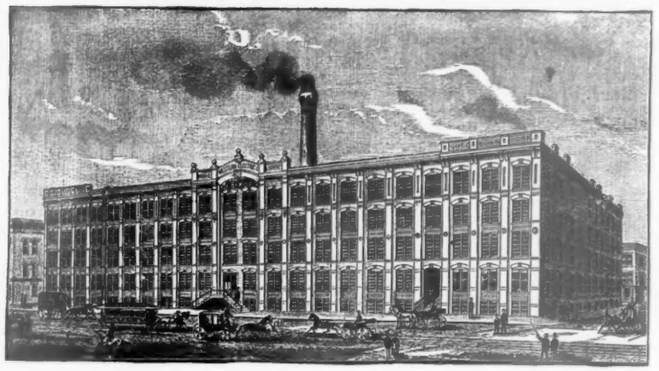

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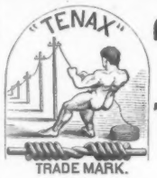

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